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The contribution of agriculture to the gross domestic product of Sudan

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THE CONTRIBUTION OF AGRICULTURE TO THE GROSS DOMESTIC PRODUCT OF SUDAN

by

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CHAPTER ONE: INTRODUCTION

Sudan like any less developed country is caught in a vicious circle of poverty. Per capita productivity is low because the country is poor - poor not in its natural resources but in its ability to utilize the natural resources available. Sudan's underdevelopment stems not from insufficiency of land as is the case with China, for example. It is underdeveloped because of underutilization of existing natural and human resources.

Positive change in per capita productivity is a basic measure of economic growth. Thus it might be used as an indicator of achievements in the standard of living of the Sudanese society. Sudan is largely an agricultural country with the largest part of its population being engaged in agriculture. The per capita productivity is low when compared to that of the advanced countries. Many problems stand in the way of achieving increases in per capita productivity. The lack of education, the low level of farming techniques, the lack of an adequate transportation system, the limited amount of capital, poor water supplies in many an instance and lack of adequate sanitary measures, etc., accompanied by an institutional setting which is resistant to change are all factors that account for the low per capita productivity within the agricultural sector.

The importance of this study lies in examining the prevailing problems facing Sudanese agriculture in the context of economic development. It is supposedly a contribution to the reservoir of knowledge which is badly needed by a country like Sudan. The nature of the

contribution of agriculture to economic growth is also of importance and relevance in this study. A consideration will be given to the main possibilities that confront the country in developing agriculture and other industries. No attempt will be made to determine the possibilities which ought to be chosen because this is a matter of policy. Moreover the study is methodological and consequently no recommendations will be involved in the study. But it is worth it to indicate the alternatives that may be chosen and which will depend on the arrangement of labor, land and capital resources within the economy; as well as the type of economic organization that is necessary for the fulfillment of increases in per capita productivity.

Adequate research and educational programs are necessary means of achieving developmental ends. It is the final aim of this study to outline the limitations hindering a satisfactory analysis of the economic situation, and to make suggestions for the expansion of research facilities which are vitally important for the development of the country.

Background and Setting

The Sudan covers an area of nearly one million square miles or approximately six hundred million 'feddans' (1 feddan = 1.038 acre). A great deal of this is of little use for agriculture under existing technology.

The total population of the Sudan today is about twelve million, while the estimate for the livestock is about twenty million. The population estimate gives a density of approximately 12 persons to the square mile. This density measure conveys little if one does not know how much

of the country is virtually uninhabited and uninhabitable. It is reasonably assumed that the country can accommodate increased population with economic benefit. Indeed, the number of annual immigrants in search of employment points to this. But it is distribution which counts as much as numbers. It is not an altogether healthy sign that the population of the larger towns seems to be increasing in number at a greater pace than the population as a whole. This statement is made with utmost reserve because the author feels that an agricultural country cannot afford to have a large number of unproductive mouths to feed and it cannot be doubted that, in the absence of a corresponding development of industry, the "drift to towns" is a real limitation to development.

The country, divided into nine provinces, is a high, broad, and generally level region. It is transected by the Nile and its tributaries running from south to north. Locally, hills and mountains rear out of the monotony.

The climate shows a wide variation. It never rains in the extreme north, whereas rain is plentiful in the extreme south so that the rainfall generally increases from north to south. This distribution of rainfall is reflected in the types of vegetation which pass from thorny almost leafless drought-resistant types of vegetation in the north to evergreen and deciduous forests in the south. The temperature shows considerable daily variation in the northern desert areas. Farther south this variation is lessened by higher rainfall and humidity, and temperatures are generally uniform throughout the year.

The economic history of the Sudan is typical for an underdeveloped

country consisting of an early establishment of a transport system and of a primary industry, with only a very recent start in industrialization. The primary industry of the Sudan is cotton growing under irrigated conditions. Mechanized (rainland) cultivation, mainly of grain, is a recent development.

Not only is the Sudan's economy almost exclusively agricultural (at least 90 per cent of its population derives its livelihood from agriculture including animal husbandry), but it is heavily dependent on one cash crop, namely cotton. In most years cotton and cotton seed account for 60-70 per cent or more of the Sudan's foreign earnings and supply the government with the largest share of its revenues (40 per cent). Cotton contributes 13 per cent to the gross domestic product of the Sudan which is smaller than the 15 per cent contributed by cereals.

Problems Investigated

In almost every economic developed country agriculture is an industry of relatively declining importance in the whole economy, decade by decade, over the long range. Most students of economic thought are content with this hypothesis as the historic developmental trends of most of the developed countries have provided them with adequate empirical information that agrees with this conclusion. Whether this is true for most of the countries now in the process of development remains to be seen. Here the specific concern is with agricultural development in the Sudan, its problems and solutions. It is not the task of this study to compile a comprehensive and consistent theory that will explain the phenomenon of a declining agricultural industry and a growing national income. But

since the investigation deals with the problems of agriculture, the task would not be completed if due regard is not given to the contribution of agriculture to the national income, and the role played by agriculture in the process of development.

The Sudan, in contrast to the economies of industrially advanced countries, has a substantial sector of its economy outside the exchange economy. Cultivators in many parts of the country consume the major part of what they produce - they establish their own homes - and they own their own cattle. Most of the people and the natural resources of the country are devoted to agriculture. These resources committed to agriculture are being utilized at very low levels of productivity. This is one of the conspicuous characteristics of the agricultural sector which is inseparable from the low level of per capita productivity that establishes the basis for the problems being investigated in this report.

The productivity of a male laborer in agriculture[1] was, before the

[1]Net productivity per male earner occupied in agriculture on the basis of the 1934-1935 crops[a]

Country	International unit	Country	International unit
New Zealand	2,444	Great Britain	475
Australia	1,524	Cyprus	143
Argentina	1,233	Turkey	109
U.S.A.	661	Syria and Lebanon	98
Holland	579	Iraq	93
		Egypt	90

[a]International unit: the amount of goods and services which one dollar would purchase in the U.S.A. over the average of the period 1925-1934. Source: Bonne (1, p. 47).

war, much lower in all Middle Eastern countries than in Europe, America and Australia (Clark in Bonne (1, p. 47). The Sudan was not included in these calculations because there were no statistics but it is unlikely that productivity here would be higher than or as high as in Egypt. There should, therefore, be ample room for improvement in productivity.

In the Sudan, there is dearth of land and labor relative to capital, and the real income per person is low because of the limited range over which labor can be substituted for land and capital to obtain a greater output or even the same total output. The per capita productivity is low and will remain low as long as the disproportion in the use of resources continues.

The problems engaged in this study may be conceived more clearly if we set the basic end-in-view to be pursued. The future of the Sudan depends on the proper use of its land as well as its capital and labor resources so the increasing pressure of the years ahead may best be met in one instance by the expenditure of state funds, in another by cooperative societies, and in another by private capital (2, p. 43). Implicit in this statement is the need for an accelerated rate of growth. In order to make this end in view more amenable to economic analysis we shall assume that the society is interested in achieving a per capita productivity in the agricultural sector that compares favorably with a growing industrial sector with the promise that the per capita productivity in the latter sector is one that maximizes returns to the resources used.

Thus the analysis proceeds by identifying the existing conditions

under which the resources are used in agriculture, and the lack of fulfillment of an optimum situation within agriculture that is incompatible with the end-in-view mentioned above. In the economy, it would appear, as we shall see later, that the available land and labor, apart from the scarce resource capital, are unused or underused. Most of what is produced is being consumed thus leaving almost nothing of what is scarce to be devoted for increasing the productive capacity of the economy. Even so, to add more to the complexity of the problem what is being produced does not provide the minimum quantitative and qualitative requirements which have to be met in accordance with man's need for food. The great majority of the people of the Sudan are on a subsistence diet which varies from year to year, depending on the weather. If they eat, they may eat of the wrong things. If they are hungry it is not because they will not eat this or that but because there is nothing to eat. More evidence that supports this fact could also be derived from the United Nations' Statistics where it has been stated that Sudan's actual caloric intake levels per person per day are below the established minimum standards by 80 calories per person per day (3, p. 20). Estimates of this nature would give rise to manifold questions as to how accurate they are; and what is actually the caloric intake in the Sudan. A substantial amount of subsistence production does not enter into the estimates, and even if estimates for the subsistence sector were made, it is quite legitimate to assume that they are understated. Whatever the case might be, the amount not estimated may still not be enough to offset the gap. Here, again the belief is that a problem exists and if the per capita

productivity could be increased the problem might no longer become an overriding issue.

Taboos, customs and prejudices impede progress. An example of this is the strong preference most Sudanese have for sesame oil over cotton seed oil. Both are said to be equally nutritious and it would be to the country's advantage if no sesame seed was crushed locally but the seed exported since it is more valuable than cotton seed. The only thing which prevents this desirable development appears to be a conservatism of taste.

However, the inquiry is to be pursued along an adjustment path within the agricultural sector that is conducive to economic progress.[2] This calls for an increasing per capita productivity and regulation of the flow of resources outside agriculture. Within this framework of inquiry, current problems of Sudanese agriculture spring from:

(1) The persistence of a low level of per capita productivity within the subsistence sector that results in a total product which is not sufficient to meet the requirements of a growing population, let alone the fact that agriculture ought to contribute to the growth of the industrial sector as well,

(2) Relative internal inefficiencies within and between various farming regions,

(3) The relatively high concentration and immobility of resources in agriculture, which gives rise to redundancy and the existence of disguised unemployment of the farm population in one instance, and the

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[2]Economic progress is defined as a secular rise in per capita real income.

wasteful use of natural resources in another instance,

(4) And above all, a relatively high birth rate among the rural people that is resulting in a continuous addition to the farm population which is greatly exceeding the rate at which people could be shifted away from agriculture by the creation of new job opportunities.

Objectives of the Study

The first objective of this study is to elaborate a model which will increase insight into the relationships between the level of agricultural productivity in terms of real per capita income on one hand and the use and productivity of resources that would achieve in advance a supposedly predetermined course of economic evolution and gradual change on the other.

The second objective is an endeavour to formulate a conceptual framework revolving around the model which will help us to concentrate on those factors, which, at any given time, are most likely to be critical in determining the cause of change and the changing relations among these factors.

The emphasis is essentially methodological, since the primary goal is to devise an analytical framework, or to put it more clearly, to adapt some of the available analytical tools in the area of economic development in order to detect and measure quantitative and qualitative restrictions that offset an optimum resource allocation.

Within the general area of developing methods for empirically testing hypotheses which have been formulated theoretically by theorists in the area of economic development, and on the basis of the methodology

proposed, the specific task will be to point out the basic resource inconsistencies in the economy (more so in the subsistence sector) that act as a barrier and a drag on the economy, and try to modify these in order to serve the aim of motivating the economy by increasing production for the market.

Finally, some suggestions will be made in regard to the collection of data that are required for empirical investigations, and from which conclusions can be drawn.

Analytical Approach

The analysis to be pursued in this study is based on very scanty data. In fact, more emphasis is placed on methodology rather than actual empirical findings. This is so because of the lack of specific empirical evidence relating to the quantitative impact of any structural reforms or changes on the economic system visualized.

However, for 1955/56 and other years the Department of Statistics has prepared an estimate of the national income of the Sudan. This effort is certainly worthwhile in giving a picture of the whole economy, but much of what is included in this series is nothing more than rough estimates and inexact measurements. This provides a foundation from which we could start to point out the general weaknesses and shortcomings whose remedy is our main concern even though such information is incomplete.

Further details on certain basic difficulties that ought to be resolved before any estimates or statistical procedures would be worthwhile, practicable, and reliable will be presented in later chapters of

this report.

The analysis will start by assuming a closed economy with an equilibrium rate of growth. Also, a proper time interval of two or three decades is assumed when the economy and the society of which it is a part transform themselves in such ways that economic growth becomes, subsequently, more or less automatic. A perpetuation of the growth process requires a society that responds to the impulses set up by the initial changes, including the potentialities for external economies[3] (Ranis and Fei 4, p. 533). Some of the most outstanding characteristics of such a process are a reduction of the rural proportion of the population, a doubling of savings rates, and the first marked and continuous flourishing of industry stimulated by the availability of surplus labor (4, p. 533). For the "basic analytical tool-kit," however, we draw heavily on the work of various authors in the area of economic development.

The model presented is a very general and highly aggregative two-sector model concerned with the sequence of development. It is a general belief that industrialization has proven to be a powerful stimulus to the development of agriculture. Most authors are content with the fact that agriculture in general, and subsistence agriculture in particular, are characterized by the scarcity of "linkage effects" (Hirschman 5, p. 109). Furthermore, the development process requires the re-allocation

[3]Implicit in the statement above is that new possibilities for productive enterprise require political, social, and institutional changes in the existing situation which will both propel an initial increase in the scale of investment and result in the regular acceptance and absorption of innovations.

of surplus agricultural workers - whose contribution to output may have been zero or negligible - to industry, where they become productive members of the labor force. Our task would then be incomplete if the study will not consider industries that will have more relevance than agriculture in the development process because their linkage effects are more significant.

The theme of our later analysis rests on the fact that agriculture is inferior to manufacturing on grounds of comparative productivity (5, p. 109), and more so because of the former's lack of direct stimulus in initiating new activities through linkage effects. This is plausible in so far as the recourse our analysis takes would be describing the mechanisms by which primary productive activities could be enhanced. It is also expected that this will lead to increased exports (besides supplying the basic necessities of life that will accelerate the real per capita productivity) that do finance imports, and which would become very powerful agents of the industrialization process.

So far, we have been abstracting from population growth as a factor that is of great importance in the process of economic development. The consideration of this Malthusian problem has given rise to the so-called "critical minimum effort" thesis (Leibenstein 6, p. 94) which deals with population as an endogenous variable of the system, and provides a framework that defines the introduction of exogenous stimuli to achieve a "more-than-temporary departure" (4, p. 534) from the quasi-stable equilibrium system. Leibenstein has not considered the absolute magnitude of effort that would be necessary to lead an economy away from the low-

income stagnation. In the course of our analysis, we shall show how a theory of demography could permit the size of the effort to vary in time with the duration of the development process, and how all this could be a useful tool for invigorating change in what is so far considered to be a stagnant Sudanese economy.

Plan of This Report

In view of the importance of the implications of the theory of economic development for every economy, particularly that part of the theory dealing with the less developed countries, the contribution of this study, then is to construct a framework of economic growth for the Sudanese economy of which the contribution of the agricultural sector constitutes the major part.

This study has five major parts.

The first part is introductory.

The second part deals with the development of a theoretical framework which presents the basic structural assumptions of the model with heavy emphasis on the analysis of the contribution of the agricultural sector. Complete analysis of the agricultural sector can be conducted only within the whole framework of economic, political, psychological, social and cultural aspects of human behavior. However, it will be a little too much for an economic system to have so many factors as mentioned above, if we want some solutions out of the system telescoped on which we can base our conclusions. In this report, however, major emphasis would be directed mostly towards the economic aspect. An endeavor would be made to explain some dynamic relations between agri-

culture and non-agriculture.

This part of the study will also contain a more rigorous treatment of the ends-in-view, and the problems mentioned before would be discussed in terms of the ends stated.

Evaluation of the model, its adjustment, and usefulness presented later in this chapter of the study would not, however, be free from certain limitations which would be relaxed by extending the analysis to non-economic considerations.

In the third part of the report the specific concern is to identify the relevant factors that account for the lack of integration of the two sectors of the economy, and the relatively low degree of development due to the inflexible structure of the economy. The deficient-productive-capacity of the Sudanese economy typified with a low level of labor productivity, a low ratio of saving to output relative to the rate of population growth, and the sub-optimum capital-labor ratio, serve as diagnostic propositions on which the investigation is compiled. The present pattern of land tenure which is the outcome of rooted tribal customs and habits in some instances, accompanied by the primitive system of land utilization practiced in most areas, have served to submerge the largest part of the economy with its most valuable human resource into a sea of subsistence activities and to keep the production process direct from hand to mouth. Imperfections and maladjustments of this nature, together with the absence of technological progress[4] and extreme scarcity of

[4]Technological progress is construed to include not only improvements in knowledge that are capital consuming, but also any possible tendencies towards the transition from a more capital-consuming and less labor-intensive process to a process characterized by saving capital.

capital, would be of particular interest in carrying out the diagnosis of the problematic propositions using the framework set forth in the preceding part of the report.

The fourth section of the report proceeds with the application of the Hirschman model to the results obtained in the previous phases of the study. This would bring the study to the stage whereby the economy has experienced a general transformation from one which has been "characterized by the lack of capital and abundance of labor, and a very small industrial sector superimposed upon, and not integrated to, a large native agricultural sector (economic dualism), to an economy in which the proportion of the labor force employed in agriculture has become small and the two sectors have become integrated (Thorbecke 7, p. 8).

Finally, the study concludes by enumerating its limitations and shortcomings, and with suggestions for further research in the extension and use of the methods presented.

CHAPTER TWO: DEVELOPMENT OF A MODEL FOR ANALYSING PROBLEMS IN AGRICULTURE

The Model

Aggregates and their inter-relationships

The function of this section as stated earlier is to elaborate a model that will aid in delineating the problems with which this study shall be concerned. As Salter put it "... a problematic situation exists whenever there is doubt as to the relation of action and outcome in experience" (Salter 8, p. 68). In this situation, doubt presently exists concerning the economic consequences of the adoption of practices that might bring about changes in the per capita productivity as the process of economic growth goes on. The purpose of the model to be constructed here is to analyse the problems of agriculture in the long-run process of economic growth with special reference to the productivity of resources.

We shall first start by introducing some of the preliminary figures and rough estimates relating to the GDP that will make it possible for us to go somewhat more deeply into the structure and growth trends of the economy.

The total value of production for the Sudanese economy is summarized at any one given point in time in the so-called "gross domestic product".[5]

[5]The "gross domestic product" at market prices as defined in a United Nations report is "the market value of the product, before deduction of provision for consumption of fixed capital attributable to the factors of production located in the territory of a given country (9, p. 49). The GNP can be obtained from the GDP by deducting from the latter income accruing to non-residents from resources located in Sudan plus income
(Footnote continued on next page)

The following table copied from a report issued by the Economic Branch of the Ministry of Finance and Economics shows the value of this aggregate, together with the size of the population for the period 1955/56-1960/61.

For convenience we shall assume that the 'traditional sector' is the agricultural sector, and the 'modern sector' is the non-agricultural sector. The latter sector is conceived as that part of the economy which is yielding a product by means of modern techniques and with the help of modern types of investment goods.

It can be observed from the table that the agricultural sector has been declining. The annual rate of aggregate growth of the non-agricultural sector during this period is 6.5 per cent, which is much higher than the 3 per cent rate of aggregate growth of the agricultural sector. The total GDP has been increasing by 4.7 per cent annually. Of course, this increase has been partly offset by the population growth which is 2.8 per cent per annum. Thus the per capita GDP has increased by about 2 per cent each year and now it amounts to approximately £s30 (1 Sudanese pound = $2.87). In view of the rapid population increase this rate of per capita growth cannot be considered as being satisfactory even though in some regions of the country the figure for per capita income might be higher than £s30. The situation is worsened more by the likelihood that Sudanese agriculture has been absorbing a considerable portion of the

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(Footnote continued from previous page)
accruing to residents of Sudan from resources owned abroad. Because the difference between the two concepts is trivial for Sudan we shall assume that GDP and GNP are equal. Also for the sake of simplicity we shall assume that there is no difference between gross and net figures. This assumption can be justified if we argued that the ratio of net national product to GNP is constant through the whole process of growth. Consequently, the growth rate of NNP is equal to the growth rate of GNP.

Table 1. The total value of production together with the size of the population for the period 1955/56-1960/61[a]

Item	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61
I. GDP (£s) (000,000)						
(a) Traditional part of economy	160.7	164.9	170.5	174.8	181.6	187.2
(b) Modern part of economy	123.5	149.7	140.9	146.9	166.2	170.0
	284.2	314.6	311.4	321.7	347.8	357.2
II. Population (000's)	10,263	10,657	10,958	11,267	11,585	11,928
III. GDP per capita (£s)	27.42	29.52	28.42	28.55	30.02	29.95

[a]Source: (10, p. 16).

natural increase in population. Furthermore, for many years the average import percentage of some principal food commodities has constituted a relatively larger share of categories of goods in the total value of Sudanese imports.[6] This in itself constitutes a heavy drain on Sudan's foreign exchange reserves. At the same time there is not quite a reasonable justification for a country which is largely agricultural to rely heavily on other countries for food imports.

So if an increase in the per capita productivity of the human resource is to be accepted and pursued as an end in view it has to be of a two-fold function.

(1) The proportion of population in the agricultural sector will have to decline, and that in the non-agricultural sector will have to expand. This means by necessity the creation of new job opportunities in the non-agricultural sectors for the workers who are to be transferred and it will be discussed more intensively in a later part of this study.

(2) The estimated future increase in demand for some of the food commodities and the shortage which might be satisfied through imports should be met by increasing the domestic production of food products, and not by increasing food imports.

The model by sectors

According to Table 1, the growth rate of the GDP over the period 1955/56-1959/60 is estimated to be 18.8 per cent. The annual rate of increase is 4.7 per cent. As the annual rate of population increase can

[6]Imports of consumer goods, mainly of food and drink account for about 38 per cent of the increase in imports in the period 1960-1961 (10, Table 19, p. 55).

be put at 2.8 per cent this means that the per capita aggregate increase is about 1.7 per cent. In comparison with this aggregate rate for the economy as a whole, the annual rate of increase in per capita agricultural productivity is estimated to be:

Per capita growth of agricultural income

$$= \frac{\text{Agricultural sector growth}^{7}}{\text{Agricultural population increase}} = \frac{3}{2.8} = 1.07\%.$$

3 - 2.8 = 0.2

By the same token the per capita growth of the non-agricultural sector is:

6.5 - 2.8 = 3.7

$$\text{PGNA} = \frac{\text{NASG}}{\text{NAPI}} = \frac{6.5}{2.8} = 2.32\%.$$

To pursue the analysis further we should go into the details of differential changes in the natural population increase and their impact on agricultural and non-agricultural productivities.

The above numerical illustration which is reasonably realistic for the Sudanese economy, assumes that the proportion of the GDP contributed by the agricultural sector is 62 per cent, and the ratio of agricultural per capita income to aggregate per capita income is:

$$\frac{£\text{s } 19.96}{£\text{s } 27.692} \times 100 \doteq 72.08\%.$$

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[7] Here we are assuming that the natural population increase in both sectors is the same even though about 86 per cent of the 'economically active' population are engaged in agricultural activities, and only 14 per cent are in the non-agricultural sector. The expression 'economically active' has been preferred to others because it is a better designation for the "labor force" in a country like Sudan. Other concepts or notions such as 'labor force' or "gainfully employed" are not particularly suited to the purpose, the reason being that not all persons are working for, or are desirous of working for an income. Also the Sudanese economy is largely a subsistence economy, and large sections of the population are not fully drawn in the money and exchange system.

The per capita income assigned by the model to persons in the non-agricultural sector is about £S 75.16. The figure for the agricultural sector, to repeat, is £S 19.96. Even though the non-agricultural sector is small in size relative to the agricultural sector, the average per capita income of the former approaches almost three times the aggregate average. Such a high ratio of average per capita income in the non-agricultural sector to the aggregate average complies with the general norm that a shift from agriculture towards industrialization enhances economic development assuming, of course, that the end-in-view is to maximize the per capita productivity. Average per capita income is not necessarily used here as a measure of relative welfare in the two sectors.

The GDP originating in agriculture is 62 per cent of the total GDP and the bulk of the population is engaged in agricultural activities. Thus it is a truism to describe agriculture as the basic activity in Sudan not only with reference to employment of resources but also with reference to total income. In contrast with the statement made above, the description of agriculture as a basic activity contributing above two thirds of the GDP implies that ameliorations in the agricultural sector must go hand-in-hand along the line of improvements in the non-agricultural sector.

It is extremely likely that the outcome of differential changes in population growth will be a heavy burden and a drag on agriculture. It follows from this that if the major increase in the population is going to occur in the agricultural sector, the difference in productivity between agriculture and non-agriculture is going to deepen in the future,

even if the agricultural output is to be expanded to meet the increasing food requirements of a growing population. Thus at least for food supplies to be maintained, labor must be shifted to industry, and agricultural productivity will have to be expanded by at least more than 2.8 per cent if this is going to be the annual rate of growth of the population in the future. Rising income levels will have to be accompanied by a corresponding change in structure; that is, a relative shrinkage of the agricultural sector. The rate at which economic development proceeds can then be described by the speed at which labor is transferred from the agricultural sector to the non-agricultural sector where new industries are established to accommodate the superfluous flow of labor from agriculture.

Formal analysis

It is assumed that the economy is composed of two sectors, the agricultural sector, and the non-agricultural sector. Assuming that the general price level for agricultural commodities remains constant an initial equilibrium situation can be defined for the agricultural sector by the equation

(1) $D_o = S_o$

where D_o stands for demand and S_o for the supply at the initial period. This identity will hold true if the rate of change of demand (d) happens to be exactly the same as the rate of change in supply (s).

Many factors may cause changes in the demand structure for food products in the long-run. The most pertinent factors in our formal

analysis will be population[8], and average real per capita income.

Now let us assume that the growth rate of the population annually is "r" and let us express the rate of increase in real per capita income as "y". Let us also denote the income elasticity of demand for farm products as "E". Then the rate of increase in demand for agricultural products, "d", can be expressed by the following equation:[9]

(2) $d = r + Ey$

Here we are assuming that an increase in the population by one individual will also increase the demand for food products by unity.

A continuation of the analysis that will lead us to what the agricultural sector might contribute to the GDP necessitates the addition of the following variables of growth:

Let "a" be the rate of growth of the total number of "economically active" laborers in the whole economy and

a_1 = the rate of growth of the laborers in the non-agricultural sector,

a_2 = the rate of growth of laborers in the agricultural sector,

v_1 = the rate of growth of the average labor productivity in the non-agricultural sector, and

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[8]Also changes in taste and the age structure might induce changes in demand. But for the sake of simplicity we shall assume that these are constant.

[9]Let us assume that the quantity demanded of farm products per individual has increased by h. Then the rate of growth of demand for food products for the whole population at period zero will be $d_0 = r + h + rh$. If we ignore rh by assuming that it is a negligible quantity, and by defining income elasticity of demand for farm products as $E = \frac{h}{y}$, we have $d = r + Ey$.

v_2 = the rate of growth of the average labor productivity in the agricultural sector.

Let us again add these notations:

L_t = total population in period t

D_t = total demand in time t

D_{it} = individual's demand in time t

$V_{2(t)}$ = average productivity of one worker in period t

$A_{2(t)}$ = total number of agricultural workers in period t.

By defining the equilibrium growth process of demand for and supply of agricultural products as that process which always keeps an equilibrium between demand and supply without causing any change of the relative prices in the agricultural sector, we can derive the following set of equations:

(3) Total population growth equation:

$$L_t = (1 + r)^t L_o$$

(4) Individual demand growth equation:

$$D_{it} = D_{io} (1 + Ey)^t$$

(5) Average productivity change equation per worker

$$V_{2(t)} = V_{2(o)} (1 + v_2)^t$$

(6) Rate of change of total number of agricultural workers equation:

$$A_{(2)t} = A_{2(o)} (1 + a_2)^t$$

By equating both total demand and total supply in period t we can derive the following equation:

$$(7)\quad D_t = L_t D_{i(t)} = L_o(1 + r)^t D_{i(o)} (1 + Ey)^t$$

$$= S_t = A_{2(t)} V_{2(t)} = A_{2(o)}(1 + a_2)^t V_{2(o)}(1 + v_2)^t$$

But since we have assumed that the total demand and the total supply are equal in the initial period, then it follows that $L_o D_{i(o)} = A_{2(o)} V_{2(o)}$, and from Equation 7 we can have the following two equations:

$$(8)\quad (1 + r)^t (1 + Ey)^t = (1 + a_2)^t (1 + v_2)^t$$

$$(9)\quad (1 + r)(1 + Ey) = (1 + a_2)(1 + v_2) \text{ or}$$

$$1 + Ey + r + rEy = 1 + v_2 + a_2 + a_2 v_2$$

According to Equation 9 the demand for agricultural commodities will grow by $(1 + r)$ with respect to population and by $(1 + Ey)$ for each individual with respect to the income. Thus the total effect of both population and income can be conveniently approximated by the quantity $d = r + Ey$ which is the rate of growth of demand for agricultural products. By following the same procedure the right hand side of Equation 9 can be reduced to $(v_2 + a_2) = s$ which expresses the rate of growth in the supply side accounted for by the increase in the per capita productivity (v_2) and the total number of laborers in the agricultural sector.

From this equation we can have three sets of relationships:

Case 1 $r + Ey = v_2 + a_2$

Case 2 $r + Ey > v_2 + a_2$

Case 3 $r + Ey < v_2 + a_2$

The first case holds true when we have equilibrium between the rate of growth of demand and supply. This condition cannot be described by necessity as the outcome of the factors interacting to bring about economic growth. Economic growth for a less developed economy means by definition a departure of the system from a position of structural disequilibrium rather than of equilibrium as Chenery and Kretschmer put it (Chenery and Kretschmer 11, p. 366). Both authors have enumerated various reasons for the existence of such a situation which are quite satisfactory when related to the present status of the Sudanese economy. Some of the reasons mentioned are "ignorance of technological possibilities" or of "consumer demands", widespread monopolies, expectation of inflation, inadequate "social overhead" facilities, and so on.

Still the analysis could be extended along the line of a competitive system which may be expected to secure an optimum use of resources. Furthermore Case 1 will also aid in giving a clue as to the reason for agriculture to decline relative to the other sector of the economy.

Hitherto our system has been a closed system and it will continue to be so. Also the condition for the equilibrating rate of demand and supply plays the important role in what follows. Now we can add four more notations to what has been accumulated in the previous pages. Let us assume that β is the rate of growth of the GDP for the whole economy, β_1 the rate of growth of the non-agricultural sector, β_2 the rate of growth of the agricultural sector, and α the proportion of the agricultural output to the total output.

Let us also denote the GDP by Y. And if we have "n" sectors in the

economy, then Y of sectors 1, 2, ..., n will take the values Y_1, Y_2, ...Y_n, respectively. The annual increments in the Y of each sector can be expressed accordingly as Y_1, Y_2, ... Y_n. Consequently the rate of growth β for the whole economy can be defined as follows:

$$(10)\quad \beta = \frac{Y_1}{Y_1} \cdot \frac{Y_1}{Y} + \frac{Y_2}{Y_2} \cdot \frac{Y_2}{Y} + \text{-------} + \frac{Y_n}{Y_n} \cdot \frac{Y_n}{Y}$$

$$\beta = \frac{Y_1}{Y} + \frac{Y_2}{Y} + \text{----------} + \frac{Y_n}{Y}$$

$$\beta = \frac{Y_1 + Y_2 + \text{----------} + Y_n}{Y}$$

Also we can derive the following relation by combining the growth factors β, β_1, β_2 and α in a meaningful manner:

$$(11)\quad \beta = \alpha \beta_2 + \beta_1 (1 - \alpha)$$

If the rate of growth of the non-agricultural sector (β_2) is the same as the rate of growth of the agricultural sector (β_1), then the proportion contributed by the agricultural sector to the GDP will be constant. This seems to be very far from the actual situation being experienced by the Sudanese economy because it implies that the levels of the per capita productivities in the two sectors are equal.

The data provided by the Department of Statistics in Sudan show that the agricultural sector has increased 3 per cent per annum on the average during the period 1955/56 - 1959/60 whereas the non-agricultural sector or the "modern part" as they call it has grown by 6.9 per cent annually during the same period. These figures are very crude estimates and no strong conclusions can be drawn from them. But from what they

appear to be it seems quite legitimate and consistent with our expectations that the "modern sector" has grown faster relative to the "traditional sector", and if this is so, then it follows from Equation 11 that α which is the share of agricultural sector in the GDP will decline from one year to another year and might probably continue to do so.

Now, let us assume that the ratio of the number of the economically active population A_t to the total population L_t is constant or is nearly the same over time.[10] Then v (the rate of growth of the average labor productivity in the economy as a whole) will be approximately equal to y. This can be shown by defining y as equal to

$$\frac{Y_{(t)} - Y_{t-1}}{Y_{t-1}}$$

$$= \frac{\frac{Y_t L_t}{A_t} - \frac{Y_{t-1} L_{t-1}}{A_{t-1}}}{\frac{Y_{t-1} L_{t-1}}{A_{t-1}}}$$

and if $\frac{L_t}{A_t} = \frac{L_{t-1}}{A_{t-1}}$

[10] The assumption made does not always hold true. Actually in the process of economic development, the ratio of the number of people who are economically active to the total population varies over time. It seems that in the long-run and in most less developed economies this ratio is slightly different as time passes by. In the Sudan the rate of growth of the total population due to the natural increase is 2.8 per cent annually and that of the economically active people is by far less than this percentage even though no figures have been made available. So, again for the purpose of convenience and clarification of analysis we can assume that the ratio is constant or the difference between the two rates of growth is negligible.

then and only then will y equal to v, so that:

(12) $\beta = v + a = y + a$

where β is the rate of growth of GDP for the whole economy, v is the rate of change of average productivity of labor for the whole economy, a is the rate of increase in total number of "economically active" laborers in the whole economy and y is the rate of change in aggregate real per capita income.

According to the assumption made above the rate of growth of the total number of economically active workers is equal to the annual rate of increase of the total population. Thus, we have one more additional condition to be expressed in the form:

(13) $a = r$.

Previously, we have also mentioned that the rate of growth of demand, d, for agricultural products can be expressed as $(1 + Ey)$, and if our assumption of the fact that the economy is growing at the equilibrium rate is not violated, then d is also equal to β_2 is equal to $(r + Ey)$.

From Equation 13 we can derive the following equation:

(14) $\beta_2 = a + Ey$.

From Equations 12 and 14 we get:

(15) $\beta - \beta_2 = (y + a) - (a + Ey) = (1 - E)y$

From Equations 11 and 15 we obtain the following equation:[11]

$$(16)\quad \beta_1 - \beta_2 = \frac{(1 - E)}{(1 - \alpha)}\, y$$

From the figures that are pertaining to the rate of growth of per capita income (approximately 2 per cent as computed previously) $y > o$, and the share contributed by the agricultural sector is roughly 3 per cent so by necessity $(1 - \alpha)$ is non-negative. If the income elasticity of demand[12] is greater than 1, then it will be expected for agriculture to increase its income more than non-agriculture does. But this is not very likely, and E might in all probability take a value between 0 and 1. In this case we can safely say that the rate of growth of the agricultural sector will always be smaller than that of the non-agricultural sector.

The difference between the rate of growth of the agricultural sector and that of the non-agricultural sector will be expected to increase with higher levels of per capita income. Historically, agriculture cannot help declining according to the nature of the structure of the economy.

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[11] Equation 16 has been derived as follows:

$$\alpha\beta_2 + \beta_1 (1 - \alpha) - \beta_2 = (1 - E)y$$

$$\alpha\beta_2 - \beta_2 + \beta_1 (1 - \alpha) = (1 - E)y$$

$$-\beta_2 (1 - \alpha) + \beta_1 (1 - \alpha) = (1 - E)y$$

$$\beta_1 - \beta_2 = \frac{(1 - E)}{(1 - \alpha)}\, y$$

[12] No empirical study has been done to examine the nature of and the magnitude of the income elasticity of demand for agricultural products in Sudan. Generally, what we can assume is that in the long-run the income elasticity of demand for food products will tend to decline in magnitude. Consequently, it might reasonably approach a value between zero and one.

This is almost a kind of a rule of economic growth.[13] This, of course, presents a formidable problem facing the Sudanese economy, and it has to be met by the reshuffling of resources in a way that will use the agricultural sector as a "labor flow regulator" provided that sufficient investments are to be made to improve the technology of agriculture and to create employment opportunities in the non-farm sector.

Appraisal of the Model

An economic model according to Tinbergen is defined as "a system of relations, describing, in an approximate way, the adaptation process of an economy" (Tinbergen 13, p. 6). The model developed in this study has given us a very rough indication of how should the agricultural sector be treated if the process of economic growth is to be speeded up. Many factors have not been taken into account. These are obviously variables which relate more to an open economic system such as imports (including capital from foreign sources), exports, consumption, and investment. Some of these variables will be dealt with more fully in the chapters to follow.

Almost the whole analysis up to now has been centered around the concept of the per capita productivity measured in terms of income. This is quite consistent with our objective since we are ultimately aiming at

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[13] Some authors like Bauer and Yamey (Bauer and Yamey 12, pp. 238-239) have refuted this argument on the basis that such countries as New Zealand, Canada and Australia have a relatively much larger agricultural sectors than some of the industrially advanced countries and yet their per capita incomes are high. But still we should not forget the fact that these countries have established industries for processing agricultural products.

the specification of a structural disequilibrium that might serve as a useful guide for bringing about pressures which call forth adjustments.

A further simplification in the model is the assumption that relates to the natural increase in population in the two sectors of the economy. Urban growth and industrial development may have caused a relatively larger growth of population in the non-agricultural sector. Consequently, it might not be quite justifiable to assume that the population rate of growth is equal in both sectors. The same argument also applies to the assumption that states that the ratio of the number of the "economically active" population to the total population is constant over time. Until we know which is true we will be satisfied for the time being with the explanations offered by our model.

Adjustment of the Model

In building up a model that might give a rough indication about future growth possibilities, it is necessary that we should use "what we know or think we know about economic behavior pattern, technology, or institutions to permit us to make predictions - more or less specific depending on how much or little we know" (Ackley (1h, pp. 13-1h). It is not an easy job to make projections in the ex ante sense with particular reference to Sudanese agriculture because of the scarcity of data and the lack of adequate information concerning the pattern of growth in the past and the structural changes that the economy has experienced, if any.

However, it is possible to make some adjustments in our model by developing it into one that pertains to the growth process of an open

system. This would allow us to include more variables like those described by Chenery and Bruno as being the ones that often provide "the principal limits to growth for the less developed countries" (Chenery and Bruno 15, p. 3). These factors as listed by Chenery and Bruno are the following: (1) The inflow of foreign resources (excess of imports over exports), (2) the present and future composition of demand, and (3) the ability to plan and carry out development activities (investment, technical assistance, etc.). Besides these, we have to have an aggregate production function that will show the national output constituting component parts of consumption, government expenditures, investments, exports and imports. This could further be broken down into sectors. The population growth, then, could be treated as an endogenous variable of the system by relating it to the rate of growth in the per capita income, rate of investment, and the ratio of the marginal cost to the marginal value productivity of capital. This formulation implies the importance of capital accumulation[14] to rapid growth, because it emphasizes the growth in per capita income as related to population growth, and the percentage of net domestic product that is invested annually. Furthermore, it links the structural relationships which we have described in our previous model with the variables that are herewith introduced. This is so, because if capital is to accumulate, at a slower rate than population growth, productivity, and therefore output per head, will tend to diminish.

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[14] A more rigorous treatment of capital accumulation will be presented in a separate section.

Again, sectoral analysis will pose some difficulties. One of the serious difficulties will be the determination of the level of investment and the capital output ratios in the two sectors. Also we ought to have some information about the movement of people outside agriculture, if any. Otherwise we have to assume that the two sectors are completely independent. This is not quite a realistic assumption even for a less developed economy like Sudan.

Usefulness of the Model

To conclude the preceding analysis we can say that our model has satisfactorily shown that there is a serious productivity problem facing Sudanese agriculture. The problem makes itself felt most when the current rate of increase in population estimated at 2.8 per cent per year persists even though it is sometimes mentioned, admittedly, that the country is, in general, sparsely populated. If no people are to be drawn out of agriculture, it seems quite a truism to assume that the rate of the per capita productivity within this sector will follow a declining trend making it possible for agriculture to play a negative role in the process of economic growth.

However, this conclusion does not exclude the possibility that the existence and persistance of the population increase (in combination with the effects of other variables such as net savings and productivity of new investment per unit of capital) may even result in a positive rate of growth of per capita productivity.

CHAPTER THREE: MALADJUSTMENTS OF AGRICULTURE

Defects in General Structures

We shall discuss in this section of the chapter resource inefficiencies caused by uncertainties arising from the conditions of tenure and the credit system.

Generally, land availability poses no great problem in Sudan. A recent assessment of what might be called Sudan's land potential, made by the Soil Conservation Department is summarized in the following table:

Table 2. The Sudan's land potential[a]

Description	Area		Percentage
	Sq. miles	Feddans	
Northern deserts	145,500	89,686,200	15.00
Marginal lands	366,175	225,710,270	37.75
Ironshore country	145,500	89,686,200	15.00
Total of land "impossible" or difficult to develop	657,175	405,082,670	67.75
Swamp	12,125	7,473,850	1.25
Southern rainlands	9,700	5,979,080	1.00
Rain flood plain	48,500	29,895,400	5.00
Central rainlands	121,250	74,738,500	12.50
Western cattle country	121,250	74,738,500	12.50
Total of land of potential development	312,825	192,825,330	32.25
Grand total	970,000	597,908,000	100.00

[a]Source: (16, p. 270).

From the nearly 200 million 'feddans' of potentially useful land it would be wise to deduct 80 million feddans of land which is more suited to livestock raising than to crop growing. This leaves some 120 million feddans potentially cultivable. It is estimated that only some six million feddans, or three per cent, at the most, are now under cultivation in any one year. This certainly leaves much room for improvement, though perhaps not as much as might be supposed. It is not within the scope of this report to make an estimate of how much land could be brought under cultivation. It is enough to show that a sufficiency of land is not a problem.

Individual ownership of land

Two types of individual land ownership are recognized:

a. "Saqiya" land which is mostly held in private ownership in small holdings and it pertains to land which is mainly irrigated by means of the Persian water-wheel. Saqiya land mainly exists along the Main Nile north of Khartoum.

b. "Selūka" land which is usually the land cultivated by a digging-stick with foot-rest. This type of land predominantly prevails along the White Nile south of Khartoum up to Kosti.

Individual land ownership was also recognized in the Gezira, but by 1927 the whole land of the scheme had been settled by adopting a course of action "to provide for the compulsory hiring of land by the Government for a period not exceeding 40 years on payment of an annual rent per acre. The Gezira Land Ordinance of 1927 which empowered this measure also provided for the purchase, on payment of compensation not exceeding £E.1 a feddan, of land required for permanent works or for seed or research farms. The owners of land which was thus rented or acquired by the

Government were given preference in the allotment of tenancies. The Government has made substantial purchases of land yearly, buying in the open market" (Tothill 17, pp. 191-192).

There also exist some instances where unregistered land in various parts of the country is held in individual ownership. According to Bolton, the fact that the Government likes to treat the land as tribal land has not deterred the people from recognizing individual ownership. Also, despite the principle that ownership is vested in the tribe, land actually passes according to Mohammedan laws of inheritance, and individual ownership is claimed with great tenacity.

Inoptimal utilization of land which is individually owned has largely been the outcome of undersized and/or contiguous holdings[15] besides other considerations. In many parts of "Saqiya" and "Selūka" land, holdings and even ownership of individual date-palms have become subdivided in accordance with normal laws of inheritance, operating through Sharia law, until in places a stage has been reached in which the owners have so small an acreage of land that they cannot support a family upon it. This has adversely affected the productivity situation and resulted in the poverty and undernourishment of the rural population in the areas concerned. Not only does the land go out of cultivation, as this is the outcome in many an instance, but also it becomes incapable of supporting an increasing population. The problem is potentially a serious one

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[15] We can also refer to undersized holdings and non-contiguous holdings as the result of land fractionation and land fragmentation, respectively. Both the former and the latter might equally well be referred to as hereditary subdivision of agricultural land which finally leads to the parcelation of lands into small units that are spatially separated.

because the different practices that are resultant of the river behavioral pattern and some traditional aspects have also contributed to parceled and scattered uneconomic tracts of land. For the most part the sloping bank and the adjoining piece in the river-bed belong to one owner who is usually the owner of the high land above (saqiya). But in some districts, the 'selūka' owners and 'saqiya' owners are distinct. In some cases the high land is sold without the sloping bank (gerf) adjoining it.

According to custom, people divide the land into rectangular blocks specified by imaginary boundaries. Also, in some other areas land ownership is vested into one person, 'Sid el Asl', while the right to cultivate without rent belongs to another, 'Sid el Mis wak'. The only benefit received by the former is a share in date palms. This system of non-contiguous and undersized holdings has arisen from the legal system of inheritance operating in the area from times immemorial; namely the inheritance by an equal division of the property among the children. Its severance is also explained by the fact that agriculture is an ancient occupation that has been carried out generation through generation under established cultural traits that cannot be given up easily. Accordingly, this has resulted in the great attachment to land and immobility of labor. Furthermore there are limited outlets outside the particular farming area. Accompanying this is the population expansion. The land area being fixed, the outcome by necessity is a further reduction in the size of the holdings.

Naturally such a situation has led to very small units in the case of undersized holdings where the factors of production cannot be

proportioned in a way that can give an optimum use out of them. In the case of non-contiguous holdings (scattered tracks) the size of units if put together might achieve some optimum allocation of the resources involved; but the various units are usually so fractioned and scattered along the landscape that the cost of using the various tracks will have to be very high relative to what it should actually be. The efficiency of production may be lost just because the farmer is travelling around the roads from one plot to another to get back and forth from the headquarters of his property. Furthermore, innovations that require bigger acreage are hindered merely because they are not practical under such a situation.

In terms of the diagnostic propositions, we have enumerated some of the failure elements in the area of the two kinds of holdings referred to previously that give rise to resource inefficiencies that stand in the way of increased productivity. Besides these there are some potential success elements which provide the basis for improvement. These potentialities are mainly latent in the area of the institutional systems and innovations.

The development of new institutions such as the creation of a central land agency accompanied with education may help stop the fragmentation process and gather the tracks into contiguous units if people are desirous of a change. There is also the possibility of the opening-up of new job opportunities in other sectors of the economy and this might help release the increasing pressure of the population. The creation of a capital intensive technology that can replace the labor intensive

technology may also serve the purpose of saving labor in the physical sense as well as substituting capital for labor in an area where labor is in surplus and where capital productivity can be greatest. This is so because the value of aggregate holdings after reorganization can exceed the value of units preceding reorganization. The surplus that might ensue from such a process could be used to improve irrigation, drainage, use of machinery (if desirable), etc.

Landlord-tenant relationship

In the early history of the country different enactments were stipulated by the Government (18, pp. 9-39, pp. 58-68, pp. 95-101). These are briefly summarized in the following points:

a. The Government can acquire land by expropriating all rights.

b. Government's consent to sales of land is required in order to check speculation and to prevent the creation of a landless class by the accumulation of large blocks of land in one man's ownership.

c. "Waste, forest and unoccupied land shall be deemed to be the property of the Government until the contrary is proved."

d. In the case of land which under the customary methods of cultivation is cultivable at irregular intervals, the fact that a person has cultivated it for whatever period, shall not by itself give him the absolute ownership of the land.

e. In the delta lands of Tokar and the Gash the Government has refused to recognize rights but has admitted that certain classes of people should be treated in a preferential manner.

f. In the course of land settlements of river-rain land and the Gezira the essence of the governmental policy adopted was to recognize claims based on continuous cultivation but not to recognize claims based only on ancient grants or on the cultivation by a claimant's ancestors of land subsequently abandoned.

g. The Government can acquire land for a public purpose on payment of compensation.

h. In certain districts the rights claimed by 'landlords' were at first recognized as "a system of hereditary landlords owning large areas", but later it was accepted that the rights exercised were rights to sovereign dues and not of private ownership.

i. In some other areas the Government has empowered some highly prestiged families on its behalf to manage all registered government rain and river land.

In contradistinction to some of the points cited above, the ruling Government at that time accepted the position that absolute individual ownership over land could be established according to Mohammedan law which recognizes sale and purchase of land preceded by first clearing of land, continuity of possession and regularity of cultivation. The outcome was, of course, a provocation of the law in many instances and disputes and conflicts which are still not resolved.

Most of the existing laws are directed towards the creation of a secure tenure system that will prevent the concentration of land into fewer hands. This was not satisfactorily achieved. Consequently, it has given rise to the landlord[16] and tenant type of tenure in some of the areas with which we are concerned here. According to a United Nations' publication "tenancy is, of course, not in itself an unsatisfactory form of tenure, where rents are not excessive and where security of tenure is safeguarded by legislation" (19, p. 15).

Generally, these conditions do not hold true. On private schemes along the White Nile complaints are frequently heard that tenancies are held by men who are not entitled to them, particularly friends and relatives of the licensee from outside the district. Also, a piece of land

[16]"Landlord" means with reference to any tenancy actual or potential, the person who has granted or is entitled to grant that tenancy.

is seldom found to belong to one man, but to the numerous heirs of the original owner. The heirs may then agree among themselves for one of them, or a nominee, to takeover the tenancy. But if, as often is the case, they fail to agree, one of them is selected by the joint board - a selection which might not be justified on the basis of equity in representation of the families inhabiting the particular area. This has led to a situation where the ownership of many plots is in dispute. Furthermore, the tenant is bound to grow certain crops by certain methods and at specific times as may be ordered by the licensee or manager. This assumes that the licensee or manager must have agricultural knowledge which is not true and exemplifies a great inflexibility which does not allow the tenant a freedom of choice.

The tenant is responsible for all the agricultural operations from the time of seed-bed preparation up to the time of harvest. Ploughing and ridging for cotton are done for him and he is charged the cost in full. He has to find his own seed, but in the case of cotton he receives it from the licensee and pays for it. He is also responsible for handing over to the management at the collecting station, all the cotton he picks, receiving in return 40 per cent of the net proceeds. Other crops are wholly his property.

It is frequently the case that the tenant's obligations exceed by far his returns. The tenant may receive loans to establish his first crops but these loans may be used for unproductive purposes. This is

normally the case because the title to land is insecure.[17] If the tenant fails to carry out any agricultural operation effectively or punctually, he may be punished by the agricultural court, or the management may arrange for the work to be done and recover the full cost from him. This is a harsh discipline because it does not recognize the physical and economic factors that reduce the responsiveness of the tenant toward hard work.

Figure 1 which is borrowed from an FAO pamphlet, written by Professor Timmons on Improving Agricultural Tenancy (Timmons 20, pp. 11-12), will help in explaining why a low security of tenancy is a powerful obstacle to economic development.

On the vertical axis we have the capitalized total return expected by a tenant from some investment, or by following some particular cropping or livestock practice. On the horizontal axis is plotted the time.

The total returns (OC) expected by the tenant from such a practice are realized in the future at some definite time (OC_1 or planning horizon), beyond which he expects no further returns - in our case it is one year. An alternative plan representing a more profitable enterprise (e.g., mixed farming) will take a longer time portrayed in the diagram by A_1. This will yield a greater return to the tenant, as shown by the amount of money A. The tenant in our case is, of course, not sure of staying on his farm for the length of time necessary to realize the return

[17] On Government schemes a tenancy is allotted for one year only, but normally it is re-allotted from year to year. Unless a tenant farms badly, he has security of tenure, and the tenancy will pass to his son on his death.

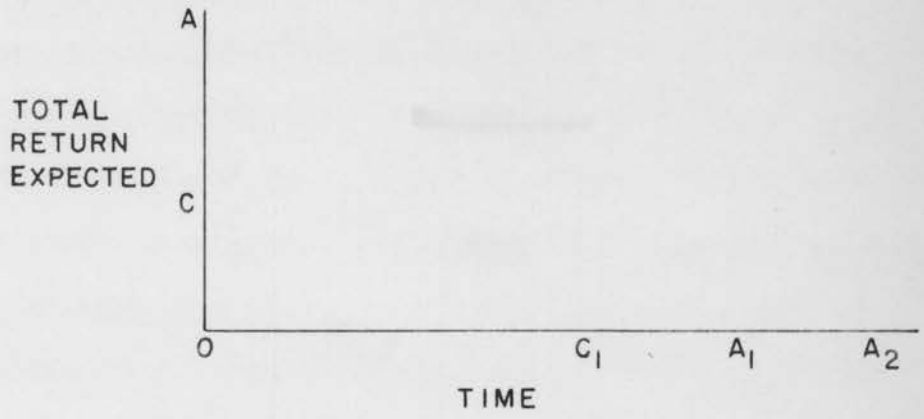

Figure 1. Expected planning horizon

on his investment in the longer-term enterprise and his planning horizon is necessarily limited to time C_1. Also, his money income is limited to amount C. On the other hand, if his planning horizon could be extended to time A_1, he will be able to undertake the more efficient and more profitable plan indicated by the amount of money A.

Timmons indicated "that beyond a certain length of time the individual cultivator's plans are unaffected by assurance of secure tenancy for a longer period in the future. For example, although the tenant may be assured of occupancy for the length of time A_2, he is not able to plan a more efficient cropping system than if his planning horizon were only A_1. Therefore, A_1 becomes the norm to which it is theoretically desirable to extend the individual cultivator's planning horizon, and the norm for extending the length of the Tenancy contract" (Timmons 20, p. 12).

Within the above framework we have limited ourselves to the exposition of some of the tenancy conditions that act as strong impediments to the provision of increased productivity of the resources available and allocated within agriculture. In summary form these impediments are the following:

1) The tenant has little incentive to increase his output because a larger share in any such increase will go to the landowner, who has incurred a smaller share of its cost.

2) In a lean year, the tenant may be left with a bare subsistence minimum with no margin for investment, and as a result he gets more heavily in debt.

3) The situation is aggravated more by the fact that an external supply of capital is not available because of its lack. Even if it is available a tenant might not be able to get it because of insecurity of title to the land.

The lessening of these obstacles will depend first on increasing the

security of the tenant's expectations by making some changes in the legal machinery that will provide for an optimum planning period. Secondly, there are great opportunities for improving the productivity of the tenant through making investments in the human element. Thirdly, a tremendous potential for a desirable change lies in launching serious efforts toward the improvement of the biological aspects of agriculture.

Tribal tenure

Tribal tenure predominantly exists in the southern part of Sudan. It also prevails in other parts of the country, but for this part of the study we shall concentrate on analyzing the situation in the southern region assuming that the approach will be applicable in other areas of the country where this form of tenure also exists with slight variations.

Almost the whole population of this region is engaged in subsistence agriculture, pastoral activities, hunting and food gathering. Without a common religious tie, without indigenous trade and with no means of transportation in most parts of the region, each tribal community produces its own requirements of all its foodstuffs. The population lacks the genuine peasant outlook which is accompanied by the low standard of crop husbandry. It is therefore difficult for agricultural development to contribute to the norm of a maximum per capita productivity.

A major part of the total land acreage of the southern Sudan is forest and swamps. The soils in the Ironstone region are very poor and the distribution of the rainfall is unreliable. High temperatures and humidities make it very difficult to store food crops for more than a few months. Thus, the physical features of the land and the

climatological factors in parts of the region place a limit on the means that can be implemented to enhance agricultural productivity. This results, as Ferguson has put it, "in the absence of a food crop surplus and make communities very susceptible to famine or to any strain on their economy" (Ferguson 21, p. 58). This situation is further aggravated by lack of indigenous trade and transportation.

The Green Belt is the one environment in southern Sudan where tropical plantation crops could possibly be grown. The conditions there suit Sudan's three most important imported food products - tea, coffee, and sugar. It is vitally important to the economy of the whole country that these good sites which exist in valleys, depressions and higher hills of the region, be protected in their natural state to conserve soil and water supplies, and to gear their use in such a manner that they can contribute to a needed increase in food production.

The most conspicuous characteristics of this part of the country are:

1) abundance of agricultural land relative to labor, and

2) a primitive system of land utilization in which the extreme lack of capital keeps the production process at a very low level.

At the present time land is held in a communal tribal form especially in the three major southern provinces of the Sudan. This area consists of about 250,000 square miles or 1/4 of the area of the whole country. The population is estimated at about 2,400,000 (22, p. 1).

Three major agricultural regions are easily recognized. These are the equatorial region, the flood region and the semi-arid region. Forests

and bush predominate the natural vegetation. A considerable amount of work is needed to clear the land and to remove the bush before the land can be utilized. Land which is under cultivation is in most cases near the vicinity of the homestead. Because land is plentiful relative to labor, an extensive system of shifting cultivation or "bush fallow" has been practised in many parts of the south. "Land is cleared and cultivated for a number of years consecutively, after which it is permitted to return to a state of bush to recover its quality" (23, p. 88). Besides the heavy expenditure of effort this is a wasteful and exploitative utilization of land and in some cases it might result in complete destruction of vegetation and consequently cause serious soil erosion that will lead to the lack of productive soil in an area where such a valuable resource should be treated with utmost reserve.

Almost all land in southern Sudan is unsettled[18] and unregistered due to the fact that land is abundant and labor is scarce. The land is held by the government in trust for the people who habitually exercise rights over it. Individual ownership as such is lacking, and the tribe has the exclusive right in its area. Each tribe is an economic unit with its own pasture and water, and each has well defined areas over which it has grazing and cultivating rights. Boundaries exist between the areas of each tribe. Rights extend to grass and cultivation only. Fishing rights go with land and a stream is divided into sections. Thus there is no individual ownership of land and the individual is regarded primarily as a member of his "clan" which owns the land. Each member of

[18]The word "unsettled" is used here to denote unsettled rights.

the tribe has the right of using the land piece which he clears and cultivates for a long time. Any areas outside this small piece are under the privilege of the tribal chief who can allot them to members of his own tribe or in some cases to strangers. This helps to strengthen the Chief's political power, and, in addition to the blood or kinship association, it aids in cementing the tribal structure. In a more primitive tribe like the Nuer, there is a "clan-owner" other than the chief, called "dyil" who acts as the father of the land and looks after its allotment. This has a religious, as well as a socio-political and economic background. Moreover, it serves the purpose of the accepted subsistence level towards which land use and tenure are directed.

As it was mentioned earlier, the government recognizes the local tribal rights and it has set reserve areas for game animals and forests. Certain laws and regulations were also enacted to control fires and wasteful hunting and food gathering. But most of these limitations have been ineffective because the settlement of the tribes who own animals has been restricted to an area which might be inadequate for supporting them and their animals. Also the poor administrative system in some instances has made the enforcement of these laws difficult and ineffective.

Attention has been drawn to the fact that the people inhabiting this region of the country are mostly primitive, still dependent upon and content with subsistence agriculture. Traditions, customs, beliefs and social values are impediments to the economic system. Taboos and magic have a place in the tribal culture. Cattle are regarded as sacred gifts of nature and the natives are reluctant to part with their animals. Cash

as yet having little attraction to most of the tribes and barter being the normal means of exchange. Most of the inhabitants of the region suffer severely from chronic forms of sickness that sapped their energy and dulled their minds; "all being subservient to a feudal hierarchy of autocratic chiefs and their every activity ordered by superstition, fear of magic and witchcraft, oracles or tribal custom" (McCall and Wilson 24, p. 2). To bring about a change that is compatible with an increase in per capita productivity, the community, or at least a part of it, might be looking forward and searching for the new, but traditions and sentiments are holding them back and making it more difficult for them to penetrate through the vicious circle of poverty. The utilization of factors of production more effectively, for the sake of development, dictates initiative and drive as well as organization which are functions of social institutions.

The above remarks show us that the increase in per capita productivity that might ensue if the development process is enhanced should be tied to agrarian reform - a concept that is open to a large number of interpretations and definitions. As Gittinger has pointed out, "Every reform must be suited to the culture that it is intended to serve. The sucess of an agrarian reform is to a large measure dependent upon the degree it can be made to harmonize with the cultural matrix and to adapt existing social and economic institutions to promote progress toward fulfilling the necessary conditions of economic development" (Gittinger 25, p. 238). This definition will suit our purpose since we are interested in generating forces from within the existing system that are

essential for altering the whole mental and spiritual outlook and that are of crucial importance for the achievement of economic prosperity, without upsetting the people.

At present, all agricultural operations in the South are carried out entirely by manual labor with the help of the most primitive implements. Animal and mechanically drawn implements have appeared recently in some parts of flood and semi-arid regions on a few private pump schemes. The use of such primitive tools is one of the major factors accounting for the low production per acre and poor quality. These primitive tools also represent a serious handicap in increasing the areas of cultivation, in better preparation of the fields and improved weeding. The cultivator faces a difficult soil to till and the implements at his disposal are inefficient. This might be exemplified clearly by showing the yields of cotton. The yield of cotton per feddan during the period of 1935-40 was just over two kantars (1 kantar is equal to 44.928 kilograms). In 1950-53 yields were estimated at 4 kantars per feddan (26, p. 348). This can be regarded as a low increase in the yield of cotton relative to the yield in other areas. And in so far as it is low, it is partly due to the present primitive agricultural tools.

In addition to the above mentioned factors, labor stands as a second major limiting factor in agricultural development. Labor is inefficient as well as scarce. Comparing data from Malakal experimental farm which is in the South, and the Gezira research farm which is in the North, weeding at Malakal requires 30 men per acre and the same process requires 8 men per acre at the Gezira. Picking cotton requires 25-30 men per

kantar at Malakal while the same work at Gezira requires from 15-17 men. The Malakal experimental farm found that no more than 4-5 hours hard work per day can be expected of the laborer (26, Table 170, p. 356).

Besides the limited supply of labor and its low effectiveness, its amount is decreased further by the amount of time spent by many cultivators in travelling between their homesteads and "out-cultivation" on the higher patches of land which are often a considerable distance from the homestead. It has been found that at the Shilluk village of Lelo the average time required to walk from the homestead to the area of cultivation was 1.15 hours (26, p. 355). Furthermore, the annual movement in search of pasture takes a considerable part of the population away from the cultivation areas. This places a limit on the availability of labor required for crop production.

On the whole, most of the tribes in this primitive social system do not react in an expected way to the stimulus of incentives. They pay more attention to the present and the immediate gain that they can attain rather than to the more distant future. Once the goal that they are striving for is achieved they lack the desire to continue work. "Sale of produce is seldom necessary, except for paying tributes in cash, for ceremonial expenses, or for buying limited quantities of consumer goods. As the need for money income is limited and probably invariable, elasticity of supply of goods or labor from many a subsistence unit is negative" (27, p. 173). Tenure uncertainty and lack of incentives are also aggravated by the lack of capital goods which curtail the productivity of labor. The natives have not developed a sense of capital

accumulation, and their marginal evaluation of work exceeds the renumeration which they might get out of it. That is to say, that the natives' needs in the south are mostly fixed and their demand schedule is inelastic. Their limited wants and needs can be met with relatively small amounts of effort. This leads to a fatal weakness inherent in tribal tenure; exemplified by the failure to meet the condition that factor rewards be in accordance with their contribution and more so to the lack of private incentive, and to reduced efficiency in resource use as well. Also shocks of weather (topographical and climatic conditions), the low efficiency of labor and the primitive implements used, the lack of administrative personnel and the limited market and marketing facilities are all factors that have a direct effect on the standard of living of the people which is based on self-sufficiency at a subsistence level. In many lean years it is even more difficult to maintain such a level of living.

The physical and the human resources of the south could be of inestimable value to the internal and external economy of the country if it is ever possible to break through the subsistence equilibrium and transform it into commercial practice that is geared for relatively high and rising production, sufficient consumption and capital accumulation. Thus some particular means which might yield consequences that are compatible with the end in view stated earlier will be to change attitudes toward work, leisure, saving, investment and the "propensity of persuasion" (Belshaw 28, p. 34). These means, if manipulated effectively, might bring about institutional changes which are conducive to increases

in output. More essential is to replace shifting cultivation by a settled form of agriculture providing for cash crops in rotations that will preserve the soil, to replace the "almost exclusively" barter economy by a cash economy, and to establish higher levels of education and health.

The previous analysis indicates that the existence of a tribal tenure system is incompatible with an expected increase in per capita productivity. By restricting land ownership to the tribe, individual initiative - presumably latent in the individual to begin with - is thwarted. Also, this restriction of land ownership to the tribe acts as a persistent failure element, hindering security of title to land and productive efficiency. The wasteful method of land utilization and the scarcity of labor in relation to land are two of the most noteworthy factors that have contributed to the low level of productivity and deficiency of real purchasing power. As Nurkse has suggested, "on the demand side, the inducement to invest is low because of the small buying power of the people, which is due to the lack of cash flow, which again is attributed to low productivity. On the supply side, there is the small capacity to save, resulting from the low level of real income. The low real income is a reflection of low productivity, which in its turn is due largely to the lack of capital" (Nurkse 29, p. 5). All this shows how difficult it is for the country to afford the provision of markets that might help in offering incentives for private investments of various kinds.

However, these obstacles need not lead us to defeatism. The inclusion of a spinning and weaving factory in the Zande Scheme of "Social

Emergence" in Equatoria Province 15 years ago[19], the assistance and encouragement by the government to some proposals for the establishment of extractive agricultural industries by private enterprise, the inestimable trials of promoting the livestock industry, the establishment of a new agricultural scheme in the flood plain region for rice production, and the extension of a railway line that connects the heart of the south with the consuming densely populated centers of the country are all bold and somewhat successful attempts to raise the social status and well-being of a remote and backward people; and to contribute substantially to the economic development of the southern Sudan. All these ameliorations have been of great value in creating an aspiration level that widened the problematic gap and gave rise to questions of research, technical assistance and education. More consideration will be given to these questions at the end of this study.

Credit system

Deficiencies in credit institutions Agricultural credit institutions vary from country to country. There is no standardized farm credit system which is fit for all countries, since the needs of agriculture differ in different countries. Consequently, under a system of commercial agriculture, financial arrangements are quite different from those required under a system of subsistence agriculture.

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[19] A capital of about $1,500,000 has been sunk in a scheme known as "Zande" Scheme in the year 1945 which, on the agricultural and industrial side, aims at the production of ample food, the cultivation of cotton for a local spinning and weaving factory, and the establishment of trading centers whereby people can sell and buy their needs in exchange for money instead of kind.

In most of the countries and particularly those which are less developed, the farm credit machinery is deficient in many ways. In Sudan one of the major deficiencies in credit institutions is that there is no substantial financial aid extended to the landless farmers and the majority of the small farm owners. Also, the existing credit institutions have not been designed in such a way so as to bring about desirable changes in tenure conditions. Furthermore, the credit institutions available in the country are not sufficient to finance the development requirements of agriculture. Thus the adverse tenure arrangements aggravated by the deficiency of credit institutions and accompanied with shocks of the market or weather are all actual obstacles to starting the process of economic development.

In most less developed countries, institutions have been established to grant credit to farmers especially in recent years. In some, direct loans are given by the government departments, but private sources of credit still predominates. In Pakistan in the past the moneylender had hardly any rival, in Malaya, Sudan and Indonesia, the most important sources of short term credit are the moneylender and the shopkeeper. The following table shows the situation of credit agencies in India which might approximate the situation in Sudan to a great extent

From the table it is obvious that the moneylender, both agricultural and private, predominates. However, in almost all of these countries direct government loans have tended to increase in recent years.

Table 3. Borrowing of cultivating families[a]

Credit agency	Percent of the total borrowing
Institutional agencies	
Government	3.3
Cooperatives	3.1
Commercial banks	0.9
Private agencies	
Relatives	14.2
Landlords	1.5
Agricultural moneylenders	24.9
Professional (private) moneylenders	44.8
Traders and commission agents	5.5
Others	1.8
Total	100.0

[a]Source: Belshaw (28, p. 58).

Cost of credit It was found by Ray that lending rates by financial institutions in the Far East range between 6-12 per cent, rarely are they lower (Ray 30, p. 184). In the Near East rates charged by official and semi-official institutions appear to vary between 4.8 and 11 per cent, some times with lower rates to cooperatives. The cost of loans from private sources is usually much higher. As an example the rate in Egypt (U.A.R.) ranges between 25 and 200 per cent, in Lebanon according to the Beruit meeting in 1953, the range varies between 20 and

400 per cent. For Sudan no statistics are available, so far, to ascertain the actual cost of lending from different credit sources, but some gathered particulars of a few specific cases show that the lending rates paid by cultivators to moneylenders and landlords frequently amount to 200% and sometimes 300%. For official banks the rate charged is 6% and for commercial banks it is about 18%, El Zobeir (31, p. 63).

These high rates are partly management wages for small and troublesome operations, and a compensation for risk. They are also indicative of the superior bargaining power of the moneylender who deals in most cases with illiterate peasants whose needs are urgent. However, these high costs are not always in direct interest rates. In the Sudan the merchant or moneylender may not charge any interest but he earns his reward by taking over the crop after harvest at very low prices and selling back supplies to the farmer at relatively higher prices than those of the market.

The economic consequences are serious. The high costs lower the range over which investment for the farmer is economic and under the existing system the cultivator finds himself severely handicapped and precarious. On the other hand, this also results in a net drain of funds out of agriculture. In many cases the small farmer is deprived of the right to keep his land when he is not regularly keeping up with the payment of his debt, and may be part of his other property and becomes only a tenant. In this way he finally becomes tied to the moneylender and loses his freedom of manoeuvre.

Even if a reasonable market price is paid for crops and charged for

food and other supplies, the conditions under which loans are given are disadvantageous. The farmer must sell at harvest time when prices are low, and buy back when they are higher. The All-India Credit Survey suggested that it would be wholly incorrect to think of the moneylender as merely looking for chances to exploit the farmers whose needs are pressing (32, pp. 174-175). He also adapts himself to them. This adaptation might take the form of "generosity" on the part of the moneylender when the farmer is faced with social obligations, religious festivals and many other innumerable social expenses.[20] Among other things, it is this adaptation which explains the survival of the moneylender in the village even in the face of government competition at lower rates and government opposition.

In the Sudan it is likely that the sources of credit to the small scale farmer are more limited relative to the large-scale farmer. This can possibly be explained by the fact that many alternatives are open to the latter because of his greater management ability and other security reasons. Thus the small and subsistence farmer might rely heavily on moneylenders and private individuals than the larger farmer who seeks loans and is able to get them from commercial banks. It seems likely, therefore, that an increase in the income and in the proportion of production accompanying economic development and generated by an increase in the productivity of the small farmer would tend to improve his

[20] Moneylenders usually give loans to the farmers without inquiring about the object of the loan, and they are prepared to lend even for unproductive purposes if the farmer promises good security and accepts a high rate of charge. They also do not insist on punctual payment.

position. But improved agricultural credit is one of the necessary requirements to be met if agriculture is to make an adequate contribution to the process of economic development.

The existing sources of credit

Moneylenders Moneylenders occupy a dominant position in the provision of credit for farmers in Sudan. They can be divided into two main categories:

1. the wealthy individuals of the village (including Sheikhs,[21] Omdas[22] and landlords) and the relatives, and
2. the town and village merchants.

The wealthy individuals supply small loans to the farmer and usually at the time when he needs some cash during the cropping season. The farmer then has to pay back after the harvest is over. In the case of relatives, the loan is interest free. However, most of the farmers give part of their crop to the relatives to express their gratitude particularly when they grow grain crops. But with the former lenders the situation is different. Some of them ask for payment only in kind (when the prices are very low), whereas others accept payment in cash, but they charge very high interest rates which are sometimes over 100 percent.

The village and town merchants usually give the farmer what he needs in the form of goods (consumption goods) all the time during the season and only give him the smallest possible amount in the form of cash. They keep a separate record, which is very inaccurate, for each farmer. Some

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[21] Sheikh is a wealthy religious individual in the village.

[22] Omda is usually the Chief of a tribe.

of them are dishonest. After the harvest, the farmer most often pays back in kind and these merchants are the ones who decide what the price of the product will be. This price is usually fixed far below the current market price. They also keep their own weights for measurement which are mostly faulty. If the farmer wants to pay back in cash, then he has to pay a very high interest rate. This sort of lender created what is known in the country as "Sheil System" especially in the northern and eastern parts. Under this system the farmer "gets goods and money to finance his farm by pledging next year's crop at a fraction of its true value (probably one half to two thirds of the lowest price the trader thinks he will get for the new crop)" Aglen (33, p. 287). Under adverse climatic conditions, the farmer cannot pay back the debts and so chronic indebtedness will ensue and hence average productivity and the standard of living will fall.

Not only this, but the picture has another unpleasant side too. The merchant who sometimes thinks of himself as being the most clever businessman will, in time, run into difficulties with the farmers which may ruin his business altogether. The cultivator is destroyed, his debts are accumulating day after day and he is not in a position to refund; the merchant is hopeless and can do nothing. His accounting books contain nothing more than the bad debts which are enough to create an unsatisfactory state of affairs.

The loan is usually undertaken at seasons of scarce commodity, and the debtor returns it at seasons of glutted market. Since prices are very high at the former period relative to the latter period, the creditor

might receive back as much as five or six times what he has originally given. The moneylender makes no distinction between short term and long term loans and there is no provision for repayment in installments. The farmer is usually at the mercy of the moneylender whenever a loan has to be renewed.

The moneylenders generally own all their working capital. But sometimes, the village moneylenders borrow from the urban moneylenders or from a commercial bank in case of those moneylenders who are also traders. The local moneylender in the village is in the position of a monopolist, as there are few agencies which are willing to lend to the farmers who are usually illiterate. The higher rates charged by the moneylenders are therefore in the nature of a tax on the illiteracy of the farmers.

The moneylenders are usually not an integral part of a well defined money market. Coordination among the various moneylenders is lacking and funds flow quite haphazardly at times when they are required most. Credit is not distributed according to the needs which will provide the basis for improving the per capita productivity. All the risks involved are concentrated on the borrower and the lender. In this case there is no organ which can act as a "shock absorber" and spread the risks over a wider range. Consequently the moneylender has to make up for the heavy risks by charging the unorganized farmers high rates of interest.

Commercial banks In the Sudan, particularly with reference to agriculture, commercial banks have been of little, if any, benefit to the cultivator. In part, this results from their small numbers and few

branches in close contact with the rural areas. It is also a result of the great difficulty in conducting business with small scattered borrowers and the greater trouble and risk involved. More important, this also arises from the small funds in relation to the needs and the greater attraction in doing business with industry. However, in areas where holdings are large and the volume of crop sold for cash is relatively enormous - like the White Nile Livelihood Schemes - then we find more activities of the commercial banks.

Commercial banks in Sudan provide short-term loans to those well known individuals on mortgage of the crops and equipment (El Hadari 34, p. 16). Also, according to their transactions with the bank. But they play an indirect role by providing loans to companies that deal with agriculture. However, they provide the loans with the condition that they handle the marketing of the crops (in case of individuals), and they charge very high interest rates - 18 per cent. In the last few years the activity of these banks has declined due to the establishment of the agricultural bank by the government.

The agricultural bank This is totally a governmental agency which has been established only four years ago. It has taken over almost all the work that used to be done by the government. The credit it provides now is the only one in the whole country that has some sort of supervision element. The credit is provided after the consideration of many factors concerning the scheme and the owner(s) of the scheme. Some of these are:

1. layout of the scheme,

2. the past history of the scheme, with respect to success and failure and the causes of these,
3. the managerial ability of the owner(s) of the scheme, and
4. whether the farmer(s) is going to follow their advice or not.

Now it has branches in the most important agricultural parts of the country. After the loan is made, in every center there are inspectors who are continuously going out to see how the farmers are getting along and to what extent they are following the advice of the authorities. The bank usually provides advice to the farmer(s) concerning the types of seeds to use, fertilizers and amounts, types of different machinery and equipment if available on the farm, insecticides and so on. Besides all this it handles the marketing of the crops to all the farmers and schemes to which it provides the loans, as well as to some of the others which do not take loans from it. The interest rate it charges is very low relative to others as it charges only 6 per cent.

The bank provides both short and medium term loans, but a weak point to consider here is the fact that it provides the loans only to the big farmers and scheme owners as well as to cooperative societies. It does not provide loans to the small farmers who need this most, although when the bank was first established the main idea was to help these small farmers and to fight the "Sheil System". So this again leaves these farmers in a situation where they would turn back and seek loans from the private lenders.

Government In Sudan, the government now plays a very limited role in the provision of loans, and this is due to the

establishment of the agricultural bank. The government is now only a partner in the "Gezira Scheme"[23] and the "White Nile livelihood Schemes"[24] where it pays the rent of the land, supplies the water for irrigation and takes care of the maintenance and operation of the "Sennar Dam"[25] and the main irrigation canals. It also provides the farmers in these schemes with loans during the cropping season to help them in ploughing, sowing and harvesting. Later after the sale of the produce, these loans are deducted from the shares of the farmers. The government usually takes about 40 per cent of the profits, the management board 20 per cent, and the other 40 per cent goes to the farmers. Out of the 40 per cent paid to the farmers as their share, 2 per cent is deducted and kept by the government as a part of the farmers' reserve funds.

This policy, where the Government takes part in such big schemes, has proved to be a very successful one, and now the agricultural bank is following the same steps in most of the newly established big schemes. Besides this, the government is now taking part in the newly established experimental rice fields in the southern Sudan.

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[23] The Gezira scheme is the largest and most important agricultural scheme in the country and it lies between the two Niles (the Blue Nile and the White Nile). The scheme has now an area of more than one million feddans and this can be extended to three million feddans. Cotton, the main cash crop in the country is mainly grown there with some other food crops for the farmers and forage crops for their animals.

[24] The White Nile Livelihood Schemes are schemes established on the White Nile area as a compensation for those farmers whose lands were flooded by the construction of the "Jebel Aulia" dam - a locality 40 miles south of Khartoum.

[25] Sennar dam is the dam constructed across the Blue Nile for the irrigation of the Gezira Scheme.

Cooperatives The cooperative societies do play an important role in Sudan. Due to the deep rooted habits of the rural population, (where people live in a more or less symbiotic manner and where the achievements and faults of a member are also of the community) and the fact that they know each other very closely, the cooperatives were thought to be the nearest solution to relieve the farmers from the grip of the moneylenders, provided that there is good management and favorable attitudes.

The Cooperative Societies Ordinance was passed by the Government in the year 1948. It is still in operation with only a few amendments made. It contains by-laws for every type of society. There are various societies, with various purposes in some parts of the country, as the following table shows:

Table 4. The position of cooperative societies in Sudan in the year 1958[a]

No.	Type	Share - capital (£s)	Reserve (£s)	Membership
118	Agricultural marketing and credit	8,226	2,461	4,752
88	Agricultural pump schemes	231,544	25,915	17,948
38	Agriculture (general purpose)	25,119	10,303	25,357
175	Consumers societies	98,532	36,019	21,725
12	Cooperative flour mills	7,564	1,667	1,424
20	Other societies[b]	18,224	4,532	24,463

[a]Source: (35, p. 9).

[b]Other societies include 3 fishermen societies, 5 cotton unions, 1 tractor society, 1 vegetable society, 1 agricultural union, 1 buttery and other non-agricultural societies.

Most of the societies shown in Table 4 are dominant in two areas (Shendi and Fung districts).[26] There are large parts of the country which are not covered with the cooperative credit movement. Even in those areas where the movement has extended there are large sections of the agricultural population which remain outside the field of membership. Furthermore, in some cases a bulky amount of the credit requirements of the members of the cooperative societies is met from sources other than the societies themselves.

The lack of capital in the hands of the local people is often an obstacle to economic development in the rural areas. The need for short term credit is in most cases decisive. This is generally supplied by the moneylenders. However, the Cooperative Department in an attempt to overthrow the moneylenders, established the "Anti-Sheil" Cooperative Societies for agricultural credit. When the farmers are interested in buying agricultural equipment, the payment is generally made by the society directly to the suppliers, and the society charges an interest rate of 10-12 per cent to the members. The Cooperative is also responsible for selling the crops and paying the debts. Supervision and control is usually under a senior official in the district. Due to the success of the first few societies, many others were established, but with the increase of number, control and supervision were not easy. Also in some societies difficulties arose as some of the farmers did not pay their

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[26] Shendi and Fung districts are two important agricultural areas. The former is a town where fruits and vegetables are grown. The latter is a main producing area for cereals mainly sorghum (Dura).

debts and they have no security (where the land is rented from the government).

In the year 1951-52, an experiment was carried out in the rainlands in which very close supervision was carried out by the government. Loans were accurately calculated to cover all operations and also the minimum cost of food for the peasant family up to the time of harvest. The loans were to be made to the members of the societies in 4 or 5 installments. The loans were given on the security of the crops and the property of the farmer. After harvesting, the marketing of the crops was arranged through the securing of contracts for the supply of grains to the government. This experiment proved to be a great success at first. But later, many of the societies failed due to such reasons as the lack of supervision, ignorance of the farmers and the 'mushroom growth' of the societies in the rural areas.

In conclusion to this section of the study we can say that the private moneylender poses an economic problem on three accounts:

1. he charges a high rate of interest, quite out of proportion in relation to the risk,
2. many of the moneylenders indulge in unfair practices and frauds and deceive the illiterate, easily cheated farmer, and
3. the objective of the moneylender is not to help the borrower to help himself, or to supply him with productive credit, but to keep him continuously in debt and work with a view to acquiring the borrower's land and property.

It is not true, however, that all moneylenders are the main causal

element of all these three offenses, but many of them certainly contribute to them and this requires measures to safeguard the farmer.

If credit is to play a more positive and dynamic role in agricultural development, then the system of credit should be strengthened at all levels and coordinated not only internally in relation to the different institutional agencies pertaining to the short term, medium term and long term credit, but also with complementary institutional arrangements for marketing, processing and other economic activities of the farmers. Credit should be granted at a reasonable interest rate for sufficiently long periods complying with the seasonality and variability of the agricultural operations it is designed to facilitate.

Within the general framework of the means-end-continuum, we have been looking at the credit structure in Sudanese agriculture for defects which stand in the way of achieving economic growth. Hence an effective reorganization of the institutions concerned and of the mechanism through which the security of the farmer's expectations could be increased,[27] should be sought for the provision of cheap and adequate supply of credit with the ultimate aim of improving the agricultural production.

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[27] What is meant by increasing the security of expectations here is to extend the planning horizon of the farmer up to a point where it would be equal to the optimum planning period, with respect to the investments necessary to bring about an increase in productivity. This could be achieved through various concepts such as the value productivity concept. Availability of data is essential for pursuing such an attempt.

Underemployment of Labor

Skilled labor (human capital)

Many writers have emphasized the role that investment can play in the education and promotion of the human element. Schultz is the most significant in this area. Also Leibenstein has used population growth as a variable that will bring about per capita "income-depressing forces" in the analysis of his "critical minimum effort thesis". It is all truism that if Sudan is to realize any economic growth, then it better invests more capital for educating its human resources which is the most valuable asset for achieving such an objective. Without education, resources cannot be utilized efficiently. Planning and research are vitally important and these cannot be carried out by ignorant people. Introduction of new techniques to improve agricultural productivity will be useless if people do not know how to use these techniques.

Schultz has suggested that investments in human agents are among the important corrective measures that will make for a better distribution of a nation's labor force over the years, particularly those investments that "enhance a person's productivity and add to his mobility" (Schultz 36, p. 294). He specified the characteristics of human resources as being primarily pertinent to "improvements in the quality of the conventional resources. They are, in the main, of the nature of human capital because they largely represent additions to the quality of the labor force and to the stock of useful knowledge" (Schultz 37, p. 35).

Following this argument it seems that the quest for a higher level of real per capita productivity will have to be made in one instance by

giving great weight to the human element. The goal cannot be achieved unless the efficiency of the workers is increased via the provision of a healthy environment with sanitation facilities and adequate educational programs. Such an approach will require, of course, the expenditure of resources and materials that are intended to raise total output and average real incomes.

Leibenstein suggested that stimulants of sufficient magnitude are important to overcome the "maximum effect" of the per capita income-depressing forces and lead the economy to sustained growth. Population has a biological maximum and in order to avoid a population explosion that might face any particular less developed economy with a disastrous situation, then the increase in investment should be more than enough to outstrip the more than proportionate increase in population. However, the Sudanese economy is not facing a population explosion but the "somewhat" stagnant human resource which is largely lying idle in the agricultural sector calls for a transformation, the outcome of which ought to be the improvement of the lot of the people in a depressed area. Overcoming the initial stage where a rise in per capita is almost the same or even lower than population growth is the "bottleneck" for the process of economic growth. Economists generally agree that, for a developing country to improve its productivity to a point where it can increase growth in per capita income, the economy has to increase capital per head, that is, an increase in capital stock more rapidly than the increase in the labor force. For the Sudan to maintain this its government ought to invest in bringing people up to a new level consistent

with building up future productivity.

Labor productivity (alternative uses)

In our formal analysis in Chapter Two we have assumed that, if the equilibrium rate of growth of demand for and supply of agricultural products is realized, there will be no effect on the aggregate prices of the agricultural products. But this does not dismiss the effects of changes in other dynamic factors such as national income, population and so on, on employment as well as per capita productivity in agriculture. The income problem may partly be explained by the income elasticity of demand for agricultural products.

In a perfectly competitive system, maximum productivity is achieved theoretically by equating the wage rate to the marginal productivity of labor. But in a dynamic system we are dealing with analytical tools of growth economics that cannot be easily reconciled with differential concepts of a static system. So it is very questionable and objectionable whether we can assume that the average productivity concept stands for the marginal productivity concept. But still this assumption is needed, and it can be rejected whenever we feel that something is known about the nature of the aggregate production function in a dynamic sense. To restate our assumption we shall equalize marginal productivity of labor to average productivity of labor in equilibrium at the initial period, and we shall furthermore assume that this equality is kept as the process of economic growth proceeds.

In our model we have assumed that the rate of growth of demand (d) is equal to the rate of growth of supply (s). And if we equated the rates

of growth of the per capita productivities over time in both sectors (y_1, y_2) then it follows that the ratio of returns to a worker in agriculture to that in non-agriculture is constant through time. Two other cases are possible and these are defined by y_1 being greater or less than y_2. The former case is, of course, more realistic but for convenience we shall proceed analyzing the equilibrium case.

Since it has already been assumed that the rate of growth of average labor productivity (v) is equal to the rate of growth of per capita income, then, we can define the following set of equations to represent the rate of growth of the non-agricultural sector and the agricultural sector, respectively:

(1.0) $\beta_1 = y_1 + a_1$

(1.1) $\beta_2 = y_2 + a_2$

a_1 and a_2 being the rates of growth of laborers in both sectors.
From Equations 1.0 and 1.1 we can derive:

(1.2) $y_1 = \beta_1 - a_1$

(1.3) $y_2 = \beta_2 - a_2$

And if we know that $y_1 = y_2$, then $\beta_1 - a_1$ is also equal to $\beta_2 - a_2$.
From this equality we get the following relationship:

(1.4) $\beta_1 - \beta_2 = a_1 - a_2$

But $\beta_1 - \beta_2 = \frac{(1 - E)}{(1 - \alpha)} \cdot y$ (Equation 16, Chapter Two)

and therefore

$$\beta_1 - \beta_2 = \frac{(1 - E)}{(1 - \alpha)} \cdot y = a_1 - a_2$$

This relation defines the difference in the rate of growth between the

non-agricultural sector and the agricultural sector as being also equal to the difference in the rate of growth of the workers in the two sectors.

Now, we want to define the relation between the rate of growth of the total workers in the economy and those of the individual sectors. This relation is expressed in terms of the growth variables a, a_1, a_2 and a constant K which implies the proportion of the number of workers in agriculture to the total number of workers in the economy, as follows:

$$(1.5) \quad a = Ka_2 + (1 - K)a_1$$

Transforming the formula (1.5) we get the following:

$$a = Ka_2 + a_1 - Ka_1$$

Subtract a_2 from both sides:

$$a - a_2 = Ka_2 - a_2 + (1 - K)a_1$$

$$a - a_2 = -a_2(1 - K) + (1 - K)a_1$$

$$a - a_2 = (1 - K)(a_1 - a_2)$$

Hence Equation 1.6 is defined as:

$$(1.6) \quad a_1 - a_2 = \frac{(a - a_2)}{(1 - K)}$$

From Equations 1.4 and 1.6 we obtain:

$$(1.7) \quad a - a_2 = \frac{(1 - E)(1 - K)}{(1 - \alpha)} \cdot y$$

From the figures made available by the Department of Statistics in Sudan, we have computed very crude and rough estimates of some of the variables defined by Equation 1.7. Others like a_2, E, K and α do not lend themselves feasible for computations and we do not want to go into the danger of assuming values that might not approximate the situation.

The computations made for the rest of the growth factors (y and a) have given the following results:

The rate of growth of labor productivity (y = v) = 1.7%

The rate of growth of workers in the whole economy (a) =

$$\frac{168,000 \times 100}{5,600,000} = 3\%.$$

What we are actually looking for is to find out the rate of growth of the "economically active" laborers (a_2) in the agricultural sector, if any. But unfortunately the unknowns are many and our behavioral equation gives no satisfactory solution.

We have assumed before that the rate of increase in the agricultural population might be of the order of 2.8 per cent. And if we consider this as an approximation for a_2 (the definition of the "economically active" laborers now being violated), then the value of $(a - a_2)$ comes out to be about 0.2 per cent. However, there is also a possibility for a_2 to tend to become zero or actually less than zero (negative). If the former case is true, then it is quite possible that the level of employment of labor has stayed at the initial situation. This, quite likely, might be the case of the population statistics in Sudan. If the latter instance comes out to be the more realistic tendency, then we have to have the agricultural population not only relatively decreasing but absolutely declining. It remains to be seen whether this absolute decline has merely been the result of a rural exodus to towns or more expansion of industries that have provided new job opportunities. Of course, both might be true.

We might safely add to our above explanation of the situation the fact that the level of agricultural employment in Sudan has stayed constant over a number of years. This is an argument that stands in favor of the speculation that employments in both sectors have stayed at the initial situation. If this is a reliable diagnostic proposition, then we shall be able to explain the phenomenon of labor redundancy accompanied by low per capita productivity in Sudanese agriculture by using the model proposed.

It seems that a difference between the rate of growth of the total laborers in the economy and of that of the agricultural workers of a very low order (or a constant figure) necessitates an absolute decrease of the number of workers in agriculture. Also, by tying the preceding argument to the annual increase in population the actual level of population adds more to the previously underemployed agricultural population, and by so doing, creates a disequilibrium that has to be adjusted for, if economic growth is to play its historical role.

There is not much data which can give a convincing proof for the analysis outlined in the previous pages. Still it is useful, even though it is not sophisticated, in the sense that it helps in understanding some of the dynamic aspects of agriculture in a less developed economy like Sudan.

Problems of Capital Availability

One of the crucial factors in economic development is the sheer scarcity of capital. The merefact that the country needs capital does not necessarily comply with a comparable ability to absorb it into

productive uses, even if we assumed that it can be made available in abundance from external sources. Efficient allocation of capital is adversely affected by a variety of non-economic considerations besides the need. In Sudan a large proportion of the scanty supply of capital is embodied into ceremonial, ethetic and symbollic form. Hence, the problem of capital involves not only its inadequancy, but also its allocation to the most productive uses. To direct an attention to the problem of accumulating or borrowing large quantities of capital ignoring the equally important aspect of efficient allocation of the scarcest resource is to shoot the shadow and miss the elephant.

Capital formation and economic growth

The amount of annual capital formation is defined as the value of the annual increase in the stock of capital goods. The "stock of capital goods" consists of fixed capital (building, equipment, etc.) and working capital (stocks of raw material, work in progress and finished goods (38, pp. 7-8). When depreciation is not deducted, it is gross capital formation which is measured. When depreciation is deducted, the result is net capital formation. In economic literature much emphasis has been given to capital formation because it determines the speed with which the national income in the future will increase. Much capital formation means a big future rise in the national income and a small amount of capital formation will entail a small rise in the national income.

To consider a good as a capital good, we must have an idea about its average life period. This is necessary because it gives us some idea about the ratio of net to gross capital formation if figures based

on estimates of past investment could be made available. This is one of the ways of classifying the composition of capital (Lewis 39, p. 212). However, equipment must last longer than one year if it is to be considered a capital good. It comprises machines, vehicles, tractors, scientific instruments and other such goods. It also includes tools but spare parts are excluded on the reasoning that the availability of a capital good during the expected lifetime requires repairs and replacement of worn-out parts.

In a less developed economy usually nothing is known about the magnitude of capital formation in the subsistance sector. For example, scanty data are available about the opening up of new lands, improvements in houses, etc. Consequently increases in the value of land and current or used assets are generally ignored. Also some goods which are treated as consumer goods in advanced countries are classified as capital goods in less developed countries. In Sudan, this is the case with sewing machines which are an essential piece of capital equipment for the tailors.

Capital formation can be divided into three major component parts as follows:

1. Source of finance which distinguishes between government, public corporations and private enterprise.

2. What capital actually consists of or the type of capital good. This is divided into the work of building and construction and the manufacture of equipment. Examples are roads, railways, houses and public utilities. According to Lewis, more than half of the capital formation

consists of work in building and construction. Hence, the expansion of capital is a function of the rate at which the building and construction industry can be expanded. In Sudan, practically all the capital equipment (machinery) is imported while all the building and the civil engineering works are by necessity done locally. The distinction made here is of use because it shows in a rough way from what sectors of production the capital goods come.

3. Finally, capital formation is classified by the industries in which the capital is used. For this to be feasible the economy is divided into a number of sectors. The distribution of capital formation over the various sectors shows the direction in which the economy is expanding.

Kindleberger argues that many systems of classification use a combination of schemes of categorizing capital depending upon ownership, physical characteristics and economic function (Kindleberger 40, p. 36). For our purpose, we shall make a distinction between social overhead capital and capital which is used for direct productive activities. Social overhead capital is composed of "those basic services without which primary, secondary, and tertiary productive activities cannot function (Hirschman 5, p. 83). The following groups can be distinguished as constituting sub-component parts of SOC: infrastructure and agricultural overhead capital. By infrastructure, we mean the framework of administrative, educational, transport, distributive, banking and public works facilities (health, power and water supply) necessary for the development of the country. It is a summation of the public services carried out mostly by the public sector. Agricultural overhead capital includes

investments in scientific technology as well as in irrigation and drainage systems. These subdivisions do not fit exactly in the classification made above and they are quite overlapping. But nonetheless, it is a convenient way of looking at capital formation from the point of view of its importance. However, SOC is generally important for its two most pertinent characteristics: (1) it is social and therefore, its cost cannot be reflected in the individual businessman cost curve, and (2) it is indivisible. Here we have excluded the "narrow meaning of SOC" that could be realized according to Hirschman by adding the condition that the services provided by SOC are of a capital - intensive nature (Hirschman 5, p. 84).

Capital used for direct productive activities may be looked at as any investment whose profitability depends to a considerable extent upon the availability of SOC.

The relationship between SOC and DPA will be explored in Chapter Four of this study.

It is generally believed that in less developed countries, the low level of productivity prevent saving which is necessary for capital formation. Statistics on capital formation are scarce. The figures available refer only to patches of the economy. A publication of the United Nations have expressed the view that in most African countries, as in other primary producing countries, the volume of investment depends on the world market conditions for the raw materials produced by these countries (41, p. 186). In many cases capital formation depends on a single crop only. Sudan is no exception to this rule. The level of

saving is low and this is aggravated more by the dependence of the economy on one crop. The Sudanese government has assigned priorities to investment in railways, public utilities, water supplies, roads, school buildings and so on. There is still much to be desired because what was done so far is not enough for the provision of a frame within which private enterprise can operate.

Kindleberger believes that capital formation is only possible when an economy can produce more of consumers' goods necessary to meet the demand of workers employed in producing capital (Kindleberger 40, p. 50). Thus, a reorganization of the production method seems desirable if the agricultural sector is to supply surplus food.

The existing institutional setting is a limit to capital formation. The government may undertake investment by borrowing money or equipment from abroad or by drawing heavily from the country's own resources. But a transformation of the institutions and social attitudes might as well be a source of voluntary saving and economic mobility. It is reasonable to assume that the encouragement of public companies in which anyone may buy shares will be a successful means of investing into productive activities.

By using Harrod's identity, we can explain the relationship between saving-investment, population growth, and per capita income growth. The rate of growth of the national income G was previously defined as the sum of the rate of growth of per capita income (y) and that of the population (r), i.e., $G = y-r$. Then from Harrod's identity we get:

$GC = (y-r)\,C = s = yC-rC$. Here yC means the rate of saving that is

needed to keep the rate of growth of the per capita national income at y per cent, and rC the rate of saving that is needed to maintain the rate of growth of the population at r per cent. C is the addition to capital as defined by Harrod and s is the rate of saving.

Assuming that the average total rate of saving over a number of years is constant, a rapid growth in population which will outstrip the rate of growth of per capita income will result in a negative rate of saving. This is to be expected because a larger proportion of the addition to capital formation has gone to feed the increased population, and a relatively smaller amount of capital formation is left to speed up the rate of growth of per capita income. On the other hand, if the difference between y and r is constant and positive, then C will go up when s rises and decreases as s goes down.

The identity GC = s is approximately satisfied if investment and saving are equal in the "actual" sense. This assumes a constant marginal and average propensity to save, which is quite a limitation in our search for analyzing the kind of effects economic growth will have on saving and investment and vice versa. Furthermore, an "act of investment" and a "capacity to save" are not one and the same thing (Nurkse 29, p. 31). Important changes may take place in the saving functions which may be related to changes in institutions. It is to be expected that the Sudanese economy will have a low saving ratio because of the inadequacy of financial intermediaries. Evidence of hoarding is by no means scarce in various parts of the country. Bullions and beads of gold never find their way into the financial stream.

The country is estimated to be investing 7 per cent of its national income in the year 1955-56 and 11 per cent in the year 1960-61. Investments by thousands of small cultivators who invest their labor in clearing and terracing the land when bringing it under cultivation for the first time are not included when these percentages were computed. This is undoubtedly considerable and so these figures are conceivably an underestimation of the realistic picture. However, if we accepted these figures, and assuming that the capital output ratio is of the order of 4:1, a net investment of 7 per cent might raise the national income by about 1.75 per cent and that of 11 per cent might raise the national income by 2.75 per cent which is almost the rate at which Sudan's population is currently increasing - or even by less than this if, as it is generally the case, the larger part of investment is going into housebuilding in towns, and the smaller part of it into productive investment. Consequently, it seems that used investment is just enough to keep pace with population growth. Nothing could be spared for raising the per capita income. To raise its per capita income, the economy has to increase the current rate of investment. Of course, we have to admit that the shift achieved during this short time, if reliable, is quite an important one as it implies that one of the necessary preconditions for reaching the take-off stage of the economy has been fulfilled.

The low level of investment accompanied with a high rate of population growth raises the question of how rapidly capital formation can be accelerated without causing a reduction in the "fruitfulness of capital" and consequently the level of per capita income. Lewis argued

on a priori grounds that "there are limits to the rate at which a country can fruitfully step up its capital formation" (Lewis 39, p. 208). Of these, he suggested the shortage of skill, and inadequacy of public utilities as being the two most important ones (given finance, suitable natural resources and appropriate institutions). Sudan is a country of ample fertile soils and rich with natural resources. But sources of finance and the availability of inappropriate institutions are actual limitations to economic growth and they cannot be given. External sources have, until the more recent years, played a minor role in financing investment. The country's own savings are low and hence they are not sufficient for financing investments necessary for carrying out productive projects. Private investment incentives are depressed due to the lack of consumer purchasing power and the inadequacy of market demand.

Capital can be highly productive if adequate measures are designed to allocate the amount of capital investment in such a manner that it will result in the optimum rate of growth. Nurkse has expressed his view on this point by saying that " ... any failure of the demand for capital can be cured or offset by deliberate measures of organization, including measures designed to close the gap that may exist between the private and the social marginal yield of capital. Surely it must be possible either to make the social demand for capital effective in private business terms or else to exercise it directly through public investment" (Nurkse 29, p. 30). In Sudan, the general picture is characterized by the predominant role of the public sector in savings as well as investments which according to the 1961 Economic Survey, accounted for about

three-fifths of the total. Notwithstanding this, private investments in industry have become quite substantial in the more recent years. This is undoubtedly due to the actual social benefits created by the public sector and realized by private enterprises. Still, the situation leaves much to be desired. Economic development ought to be planned with the objective of motivating the private sector. If desirable utilization of the nation's resource is to be achieved, we ought to realize the importance of the interconnection between consumers and investors whether they belong to the private sector or the public sector.

The rapidity with which capital formation proceeds will also depend, other things being equal, on the availability of skill and the expansion of building and construction. These are scarce resources in Sudan in the sense that their presence is indispensable for economic development. The choice and priority of projects within various sectors of the economy must take account of the availability of limited resources. So far, only capital was considered as a scarce input. Sudan has a great shortage of skilled labor. This manifests itself everywhere and it is one of the main obstacles to the achievement of increases in per capita productivity. The shortage of skilled labor is perhaps most badly felt in the maintenance of agricultural and industrial equipment. This accounts for stoppage in production and for a shorter-life of the equipment itself. Post-secondary education is scarce. For any project to be carried out, a specified number of well-trained personnel technicians is necessary. The productivity of the workers drawn from the rural areas into the recently started building and manufacturing industries is very low. Hundreds of

laborers walk with tiny baskets between a concrete mixer and the place where the structure is made. The potential success element lies in the fact that skill can be imported or it can be acquired through training. Training will take years to remedy the situation, but aid from foreign countries will be expected to close the gap.

The capacity of building up roads, railways, house and public utilities for speeding up the pace of economic growth through capital formation is enormous. It has often been expressed that "at the earlier stages of economic development, the greatest need for capital is for public works and public utilities which are not directly open to private foreign investors; so private foreign investment is of limited relevance to the capital needs of less developed countries" (Lewis 39, p. 213). Moreover, the public sector certainly cannot spend more on capital formation than the means available. These means are limited. Expansion of the economy is not a function of the government but it is a burden on the individuals as well. We ought to admit here that the government might allocate the means available to a development project in such a way that they will not exceed the total requirements granted that the returns obtainable from the accomplishment of any one particular project will be balanced with the benefits accruing from the same investment if it has been used elsewhere. This is a basic necessity if new enterprises that need communication, water supplies, electric power and other such services are to be stimulated. But an encouragement of this type is not by itself a sufficient condition for activating the private sector to play its role in the pursuit of economic growth. This is so because

private spending on capital formation is restricted by the value of equipment and building materials, which the private sector is allowed to purchase from abroad. Also the government has enacted a law which does not provide more encouraging premises to prospectors (Abulela 42, p. 5). Therefore, it might be wise to alleviate some of the severe restrictions that limit the flourishing of private enterprise and the role it can share in enhancing capital formation.

Productivity of capital

The relation between capital formation and a future increase in income can be measured by the capital-output ratio. Mahalanobis has given an indication of a formula that relates growth in per capita income to population growth and to the percentage of Net Domestic Product that in invested annually. It is suggestive to observe what estimates of the growth in per capita income are given by the formula under various assumed conditions. The formula is (Mahalanobis 43, p. 25):

$$y_t = y_o \left(1 + \frac{a}{b} - r\right)^t$$

where y_t = per capita income in year t,

y_o = per capita income at base year,

a = annual rate of investment,

b = ratio of cost of marginal increment of capital to the annual value of its output, and

r = annual rate of population growth

The formula assumes that the value of a, b and r will be constant. An acceptable ratio of the cost of the marginal increment of capital to to the annual value of its output in a developed country is about 4 to 1;

but whether this ratio is higher or lower in less developed countries is a point about which there has been considerable discussion (Lewis 39, p. 201). Less developed countries tend to be relatively more efficient in making consumer goods than in producing capital goods, and this tends to raise the ratio of the cost of capital relative to its output. Also tending to raise the ratio is the fact that machines and equipment are less well maintained in less developed countries; hence depreciation rates are higher. Because of this it would be desirable to keep the cost of capital goods as low as possible by avoiding greater waste of capital. On the other hand, the ratio, which will vary in different sectors of the economy, is likely to be relatively low in agriculture, and since agriculture is predominant in less developed countries, this tends to lower the overall ratio.

Pertinent to the formula is the rate of population growth. Sudan's population is growing rapidly. Higgins argued that there is some evidence that the incremental capital output ratio is lower where population growth is more rapid on the grounds that capital will probably yield a greater output if it is associated with a rapid increase in labor supply. Also rapid population growth precludes waste of capital by assuring markets for almost any investment; and more capital will be needed for housing which has a low capital-output ratio (Higgins 44, p. 648).

However, "if we assume that 7.5 per cent of the Net Domestic Product is invested annually; that the ratio of the cost of the marginal increment of capital to the annual value of its output is 3 to 1; that the population increases at the rate of 2.5 per cent a year - then the formula

indicates that the per capita income will remain unchanged. It is assumed here that changes in consumption do not affect the will to work. With any lesser percentage, the per capita income will decline. On the other hand, if 10 per cent of the NDP is invested annually, it will take about 90 years for per capita income to double. And if 15 per cent are to be invested, for per capita income to double, it will take about 3 years. In the year 1955-56, net investment was 7.9 per cent of NDP. If this rate is continued, it will bring about a very slight rise in per capita income" (Harvie and Kleve 45, p. 89).

Such relationships are not to be received as empirical laws. The evidence is too scanty for them to be treated as such. The Mahalanobis' formula even though it is highly aggregative, does indicate the importance of capital accumulation in a country where the population is growing rapidly. For if capital accumulates at a lower rate than population growth, productivity, and consequently output per head, will tend to decline.

The incremental capital output ratio which is also a measure of the productivity of capital is a means for determining total capital requirements.[28] Thus it is worthwhile to look at the value of this ratio as it has been calculated for a number of Sudanese agricultural and industrial projects being undertaken in recent years.

Considering the projects (Table 5) on the basis of their capital-

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[28]Higgins is of the belief that planners should not use the incremental capital output ratio as an instrument for determining priorities; the reason being that the choice among investment projects should be based on their contributions to income during a crucial period rather than on the incremental capital output ratios (Higgins 44, p. 643).

Table 5. Capital coefficients for some Sudanese industries and agricultural schemes[a]

Project	Gross c/o ratio	Net $\frac{c}{o}$ ratio
Public utilities[b]	7.0	8.9
Manufacturing industries[c]		
Sweet factory	2.85	5.7
Cigarette factory	2.1	2.7
Packing materials factory	1.6	2.1
Shoe factory	1.5	1.7
Aluminum factory	0.5	0.5
Perfumery	0.45	0.45
Building and civil engineering[d]		
One European-style building	0.20	0.20
One civil engineering	0.80	1.40
Managil extension		
Without share in Roseires dam	2.0	2.0
With share in Roseires dam	2.5	2.5
Cotton pump schemes		
Without share in Roseires dam	1.1	1.1
With share in Roseires dam	1.7	1.8
Pump schemes in Northern Province		
Without share in Roseires dam		
Scheme No. 1	5.5	7.1
Scheme No. 2	0.7	0.7
Scheme No. 3	3.8	4.5
Scheme No. 4	0.9	0.9
With share in Roseires dam		
Scheme No. 1	10.5	13.5
Scheme No. 2	2.5	2.6
Scheme No. 3	14.1	16.6
Scheme No. 4	2.0	2.1
Mechanized rainland schemes		
Without share in development expenditures	0.5	0.5
With share in development expenditures	0.8	0.8

[a]Source: (46, pp. 117-119).

[b]The capital-output ratio is based on three schemes. The ratios for these schemes are 2.3, 7.8, and 15.2 and the average is 7.0.

[c]The capital-output ratio here was calculated for seven recently established manufacturing industries.

[d]Available information only concerns one building firm and one civil engineering firm.

output ratios, it is obvious that mechanized rainland cultivation, the building firm and the civil engineering project have the lowest capital-output ratios. The ratio is highest for public utilities and schemes No. 1 and 3 in the Northern Province. Somewhere inbetween we find the rest of irrigated schemes in agriculture and manufacturing industries.

The prevalence of low coefficients in the case of mechanized rainland cultivation and building and civil engineering may partly be due to bumper crops in the case of the former and the utilization of cheap labor in the case of the latter. In Sudan, on rainlands, a small investment in better seeds, fertilizers and insecticides, accompanied by an improved system of crop rotation, would be likely to bring a spectacular increase in yields. On the other hand, as we have indicated previously, the low ratio in the rainlands might have possibly resulted from an increase in population which has consequently led to an expansion of the traditional rainland cultivation, and which therefore has resulted in an increased output that lowered the ratio.

On the other extreme, the high ratio in public utilities and some of the irrigation projects is to be expected on the basis that such projects are capital-consuming and very costly indeed. The high ratio of public utilities relative to manufacturing is to be appreciated in the earlier stages of economic development on grounds other than its immediate contribution to the national income. This sector enjoys substantial "economies of scale" which will lower the ratio rapidly as economic development proceeds. Lewis extends the argument to the whole economy by adding that when capital is invested in a public utility, it

may increase productivity not only in that utility but also in the rest of the economy; hence the net outcome for the economy as a whole at a later stage of economic development may be a low capital-output ratio (Lewis 39, p. 207).

The extremely high ratio in the case of the two pump schemes might be indicative of greater waste of capital. Mal-investment due to greater ignorance of what is profitable and high depreciation rates due to the lack of technical knowledge is by no means uncommon.

It is also evident from the figures above that the capital requirements of some of the irrigation schemes are nearly equal to those of manufacturing. This might be indicative of the equal weight given to agriculture and industry by the "policy-maker." Generally, substantial differences exist between the capital requirements of agriculture and of manufacturing. Furthermore, a lower degree of the mechanization of agriculture relative to manufacturing ought to put the ratio of the former at a lower level than that of the latter. But, again the low ratio in factories may partly be explained by the introduction of hand-labor and "more shifts in working hours" (Tinbergen 47, p. 76). The capital-output ratio in agriculture is not as low as is generally known. In the short-run, we will expect the marginal productivity of capital to be low but permanently the potential productivity is high. On irrigated land, heavy investment in irrigation is necessary before the land can be brought under cultivation. Gravity irrigation facilities in the Hanagil extension and other areas involve quite heavy investments and therefore the total fixed costs are very high. Furthermore, no one individual farmer in this

area can establish a project by himself. Thus, such facilities, even though they have a relatively higher initial level of investment, yet in the longrun, their pay-off is expected to be tremendous because of the accrual of greater increases in productivity.

In computing the above ratios, capital is defined as the value of capital goods at cost purchased or built and output as value added. Value added is calculated as value of sales minus expenditure on goods and outside services.[29] Value added inclusive of depreciation is used for computing the gross capital - output ratio. When depreciation is deducted, the net capital-output ratio is obtained.[30]

Because capital-output ratios are meant to be applied to determine capital requirements of various projects (future investments), it sometimes makes sense to work with average yields and expected prices. Tinbergen suggests that capital per head figures are perhaps even more appropriate than the capital-output ratios by reasoning that it is "the relative factor endowment of a country that should be one of the basis for choosing industries; and for the country under concern, it will be easier to know the number of persons employed whereas the quantity of

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[29]Expenditure on goods and outside services is equal to rent, raw materials, spare parts and outside services for maintenance, fuel and water, transport charges, packing materials and so on.

[30]The gross capital-output ratio is some multiple of the net capital-output ratio.

Let σ_1 - gross $\frac{C}{O}$ and σ_2 = net $\frac{C}{O}$. X is amount of depreciation. Then $\sigma_1 = \lambda \sigma_2$, and if o is value of output, λ is then equal to $\frac{o}{o-x}$. From this equation, it is clear that λ is high when o is small and x is large.

output might be overestimated" (Tinbergen 47, p. 72). It should be stated that the figures obtained in Table 5 are very rough estimates only since no corrections are made for price changes between year of purchase and census year. In addition, the estimates given are subject to a greater margin of error because the figures from which they have been computed were made available only from a short period. However, the use of capital-output ratio as a determinant of capital requirements for various projects is surrounded by many difficulties which ought to be avoided if serious handicaps are to be precluded.

So far we outlined how to determine the capital requirements through the capital-output ratio. The next step is to indicate how many projects can be designed with a given total investment. Tinbergen has pointed out some simple measures which may be of help in the selection of projects that might produce target increases in per capita income (Tinbergen 47, pp. 29-45).

A first simple test is based on the phenomenon of complementarity. Certain facilities will be found necessary because they perform auxiliary functions for more primary objectives. "Perhaps the most important general example of this principle is to be found in investments in transportation facilities and in power plants. Both transportation and power are needed in almost every type of production" (Tinbergen 47, p. 31).

To increase capital yields the extension of such types of projects is necessary. Complementarity in Sudan might be explained on the basis of the technical relation that exists between different parts of a gravity irrigation project. Building a dam must necessarily be followed by

digging a system of irrigation channels. Or digging the main canal is by necessity followed by digging the subsidiary canals.

We may be a little bit more specific on the relation between the cost of a dam and the cost of complementary irrigation works. In the Nanagil extension, we have an example of this relation. In so far as stored water is used for irrigating new areas, every pound spent on a dam entails more pounds to be incurred in complementary irrigation works. Of course, part of the stored water may be used for intensifying crop rotation in existing schemes. Still this relation is of considerable interest to the economy since new irrigation projects will soon be constructed. Investment in irrigation works are, therefore, bound to remain as important for capital formation as is transportation also.

A second number of tests is based on the consequences of a project. There is first the contribution to the national income made by the project itself (Tinbergen 47, p. 33). This consequence is measured by the capital-output ratio. The level of the capital-output ratio for any specific production process is first of all based on the technical relation between output and equipment. Equipment and output may be measured in physical terms. In this way a capital-output ratio can be calculated for each production process. And these capital-output ratios are data for economic policy. Within these technical limits the ratio will vary with the time the equipment is utilized. When output and capital are expressed in monetary terms, the ratio can vary much more. Production processes, employing various techniques, may lead to the same output but the capital-output ratios will differ. Furthermore, as soon as capital

and output are values, the ratio will depend on prevailing prices. The policy-maker can influence the degree of utilization by regulating the flow of raw materials from abroad, the choice of technology by preferring modern equipment to primitive techniques, and the prices by fixing the cost of capital equipment by levying import duties on them. And to the extent that these influences are possible, the capital-output ratio is an instrument of economic policy. This means that, by keeping the capital-output ratio low, the policymaker can make increases in income less costly.

Beside these direct consequences, a project has indirect and secondary consequences in the terminology of Tinbergen (Tinbergen 47, p. 33). Indirect consequences are to be found in the stages of production vertically related to the new production, i.e., "the stages preceding or succeeding the process involved." Tinbergen gives as an example a project of land reclamation which will enable a certain region to produce more sugar cane:

> "An indirect consequence of producing more sugar cane may be that more raw sugar will be produced; a second that more refined sugar will be produced; a third, that more refined sugar will be distributed. Should the increased production at each of these stages of industry and trade be ascribed to the land reclamation project? That depends on the circumstances. If there is idle capacity to produce raw sugar from the cane, it is correct to attribute the increased raw sugar production to the reclamation scheme; if there is no such idle capacity, it is not correct. If the country concerned has been importing raw sugar to supplement its own production and refining it, then the refining process should not be imputed to the reclamation scheme. And so on" (Tinbergen 47, p. 33).

It seems that the indirect effect on the national income may be described as the increase in national income due to a better utilization

of capacity already existing in stages of the production process vertically related to the new project.

Secondary effects are the changes in the national income as a whole due to the rise in income in the new establishment itself and in the stages vertically related to it. The new income earners will spend part of their money on imported goods and part on locally produced commodities. This last type of expenditure will increase the income of those who produce these commodities and so on.

The various principles discussed so far do not take into consideration the length of the period between the moment the construction of a project starts and the moment its effects are fully felt or in other words, whether a project is quickly yielding or not, or, in still other terms, the length of the gestation period. A project with a short gestation period is to be preferred, ceteris paribus, over a project with a long gestation period.

The choice of certain projects, together forming a program, out of a larger number of available projects must also take account of scarce resources particularly the limited amount of capital available for securing such projects.

Distribution of saving and investment between agriculture and non-agriculture

In this section our analysis draws heavily on the paper written by Professor Ohkawa of Hitotsubashi University (Ohkawa 46, pp. 46-60). This work has been chosen because of the fact that the Japanese economy bears some resemblance to the Sudanese economy in the sense that both

economies have a productivity problem even though Japan has enjoyed a relatively higher rate of economic growth. This does not entail by any means an indiscriminatory application of the measures used for curing the Japanese problems to the Sudanese economy. Emphasis on the country's structure ranks first and what is true under one set of conditions must not be transplanted under a different set of conditions.

By assuming that the economy is growing along the line of equilibrium, investment is always equal to saving in the economy as a whole. However, this does not mean that investment and saving are also equal in both sectors of the economy. Here, some difference is assumed to exist between investment and saving which normally appears in each sector. The following notations are then developed:

G_1 = the rate of growth of income of the non-agricultural sector,

G_2 = the rate of growth of the income of the agricultural sector,

C_1 = the marginal coefficient of capital in the non-agricultural sector,

C_2 = the marginal coefficient of capital in the agricultural sector,

S_1, S_2 = the rate of saving of the non-agricultural sector and the agricultural sector, respectively,

u, v = the difference between investment and saving in each sector, respectively, and

α = the proportion contributed by the agricultural sector to the net national product.

From these notations, the following set of equations is developed:

(3.0) $G_1C_1 = S_1 + u$

(3.1) $G_2C_2 = S_2 + v$

Then Ohkawa argued that the relation:

(3.2) $u(1 - \alpha) = \alpha v$ follows between the terms u and v, α being the weight of net product of the agricultural sector to the national net product.

From Equations 3.0, 3.1 and 3.2 we get:

(3.3) $(G_1C_1 - S_1)(1 - \alpha) = (G_2C_2 - S_2)\alpha$

By rearranging this equation, we obtain:

(3.4) $$G_2 - S_2/C_2 = \frac{G_1C_1 - S_1}{C_2} \cdot \frac{1 - \alpha}{\alpha}$$

(3.5) $$G_1 - \frac{S_1}{C_1} = \frac{G_2C_2 - S_2}{C_1} \cdot \frac{\alpha}{1 - \alpha}$$

$\frac{S_2}{C_2}$ and $\frac{S_1}{C_1}$ will be called "growth possibility rates" according to Ohkawa and this means the rate that would have made g_2 and g_1 of growth if the whole saving made in any sector of the economy would have been invested in that sector. Thus, Equations 3.4 and 3.5 are rewritten as follows:

(3.6) $$G_2 - g_2 = \frac{u}{C_2} \cdot \frac{1 - \alpha}{\alpha}$$

(3.7) $$G_1 - g_1 = \frac{v}{C_1} \cdot \frac{\alpha}{1 - \alpha}$$

This kind of model renders itself useful for the detection of some historical trends in the factors constituting it. During the process of economic development, the numerical values of these relations will be determined by the behavior of investment and saving.

Now we can make some hypothetical figures that can fit the above model for the sake of explanation. The following figures are by no means exact and they are a mere speculation.

A hypothetical formulation

G	4.7%	α	0.6
G_1	6.5%	$1 - \alpha$	0.4
G_2	3 %	$s = GC$	18.8%
$G_1 - G_2$	3.5%	G_1C_1	32.5%
C	4.0	G_2C_2	6 %
C_1	5.0	$G_1C_1 - s$	13.7%
C_2	2.0	$G_2C_2 - s$	-12.8%

Given the stage of economic development, if the marginal productivity of capital[31] is smaller in the agricultural sector relative to the non-agricultural sector, saving in the former ought to flow out to the latter sector to be invested there. From the hypothetical formulation above, G_2 G_1; also C_2 C_1. Hence the investment requirements that are needed by the agricultural sector to maintain the growth process are necessarily smaller than that of the non-agricultural sectors. It is therefore conceivable that the direction of flow of saving ought to be from the agricultural sector to the non-agricultural sector. This is particularly true of Sudanese Agriculture where government buildings,

[31] Here we are assuming that the marginal productivity of capital is equal to the incremental capital-output ratio (C). This is quite realistic granted that we are operating with redundant labor at a zero cost level. Hence an increment in capital can be associated with an increase in labor and yet will give the same result under these conditions.

transportation and other administrative and social services are largely financed through the exploitation of the agricultural sector. This is an argument which suggests that "the transition from a level of saving and investment that spells stagnation to one permitting a tolerable rate of economic growth cannot be achieved unless agriculture makes a significant net contribution to capital formation in the expanding sectors" (Johnston and Mellor 49, p. 579). Nothing can be more suggestive and explanatory than the words written by Professor Heady in describing the divine role of agriculture:

> "Agriculture has played an important role for most nations up to and as they moved into the take-off stage towards maturity in development. This contribution often was less importantly that which might be indicated as "directly and biologically fundamental and obvious," and more that which was indirect and less apparent. In the primitive stage, of course, productivity of labor had to be increased to a point where some was freed from husbandry for other sectoral occupations. Workers could be released from food production to plant the first seeds of general economic progress only with development of agriculture. Too, food industry had to grow so that population, industry and commerce as well as agriculture could increase" (Heady 50, p. 84).

Inadequacy of Technological Inputs

The low level of per capita productivity can be explained partly by deficiencies of indigenous farming methods. The low standard of crop husbandry, the prevalence of pests and diseases, the scarcity of knowledge regarding breeding, rotation, seed selection, use of fertilizers, etc., and taboos and prohibitions that make the adoption of certain techniques difficult are all indicative of the relative resource inefficiencies in agriculture. The availability of potentially cultivable land alone permits the expansion of production simply by extension of indigenous

practices and techniques. But as Johnston and Mellor suggest:

> "The most practical and economical approach to achieving sizable increases inagricultural productivity and output lies in enhancing the efficiency of the existing agricultural economy through the introduction of modern technology on a broad front. Of particular importance are expenditures for 'developmental services' or 'unconventional inputs' such as agricultural research, education, and extension that broaden the range of alternative production possibilities available to farm operators and strengthen their capacity to make and execute decisions on the basis of more adequate knowledge of agricultural technology" (Johnston and Mellor 49, p. 569).

The potential capacity of improving agricultural production and developing the economy throughout the world is enormous. Differentiated technology has reached an unprecedented standard. Modern science has created an enormous arsenal of means and methods capable of influencing any deficient organizational setting pertinent to any one particular community. A large reservoir of knowledge has been made available by man for man's dignity and comfort. This technological potential is a challenge facing the less developed countries. Sudan, like any less developed economy ought to search for those technological devices that will increase production most; and select the ones that will turn the potential improvements into actual results.

Professor Hendy proposes that in the long run, world agriculture can be represented by a single production function. The production function suggested is the following:

$$O = F(X_1, X_2, \ldots X_G \mid X_{G+1}, X_{G+2}, \ldots X_H \mid X_{H+1}, X_{H+2}, \ldots X_K \mid X_{K+1}, X_{K+2}, \ldots X_N)$$

Where O is output, $X_1, X_2 \ldots X_G$ are technologies of the past. These

are irrelevant resources because their prices are too high relative to their productivities and they are not in use any more. There are exceptions. For example, in certain parts of the world, animal power is still used and the prices are low relative to the productivity,

X_{G+1}, X_{G+2}, ... X_H are the relevant resources because their productivities are high relative to their prices and therefore these resources substitute for the preceding category of resources,

X_{H+1}, X_{H+2}, ... X_K are all known resources but their productivities in an economic and technical development sense are not yet identified. Generally, their supply price is high. So, also their productivity is low relative to prices,

and X_{K+1}, X_{K+2}, ... X_N are the resources that exist in nature, but scientists have not discovered them yet. These are referred to as "inputs behind the technological curtain."

The perpendicular lines separating the different categories of resources will shift depending upon factor prices, and they might as well be referred to as the boundaries that define various stages of economic development. The extent of the shift will determine the rate at which a particular economy is growing. Sudanese agriculture can be represented adequately by that part of the production function lying somewhere between the first and the second category of resources.

Tinbergen and Bos have suggested that the Cobb-Douglas function is one of the very few production functions presented and tested so far, and accordingly, it makes sense to study technological changes applying to that function (Tinbergen and Bos 51, p. 38). Taking capital and labor

as the only inputs, a generalized version of the function that represents the process of production runs as follows (Verdroon 52):

$$Y = B\ a^{\lambda}\ k^{u}\ e^{vt}$$

in which:

Y = national product;

B = constant;

a = labor force;

k = stock of capital goods;

e = base of natural logarithm;

λ and u = elasticities of production with regard to labor and capital, respectively;

v = rate of technological progress; and

t = time.

The Cobb-Douglas function can be interpreted as follows: the output depends on the labor force, the stock of capital goods and an autonomous trend in productivity. The connection between labor force and the stock of capital goods on the one hand and the national income on the other is laid by constant elasticities. Each of the elasticities, λ and u, is under 1 and their sum is sometimes put at 1. In such a case, a proportionally equal increase in labor force and capital goods will result in the same proportional increase in output. If one of the production factors only increases, a certain proportional increase will result in a smaller proportional increase in output. If the stock of capital goods increases the output will increase in a smaller proportion, that is, successive additions of equal quantity to the stock of capital goods will

produce an ever decreasing addition to the output.[32] This is the same as saying that the capital-output ratio is high and it is quite consistent with the argument presented previously for capital consuming projects.

Capital is a scarce resource. Labor is relatively abundant. Each input combination can represent a technological process depending on the degree of intensity with which a particular factor is in use. Tinbergen and Bos have presented such technological possibilities with the aid of the diagram (Figure 2), plotting the quantity of labor along the horizontal axis, and the quantity of capital along the vertical axis (Tinbergen and Bos 51, pp. 37-38). Process 1 uses C_1 of capital and L_1 of labor, Process 2 uses C_2 of capital and L_2 of labor and so on. The former process is more labor consuming and less capital - intensive than the latter process, and a transition from the former to the latter process constitute a technological change which saves labor and requires more capital per unit of product. In this context, we may speak of the substitution of labor by capital. The authors also define pure factor-saving changes as cases where either labor or capital are saved with no sacrifices in capital or labor, respectively. The various sets of points in the figure suggest that there are different ways of producing any one commodity.

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[32] When capital goods only increase, the Cobb-Douglas function is reduced to:

$$Y = AK^u$$

Where A is a constant and is equal to β a e^{vt}. As $u < 1$ the function will rise at an ever decreasing rate.

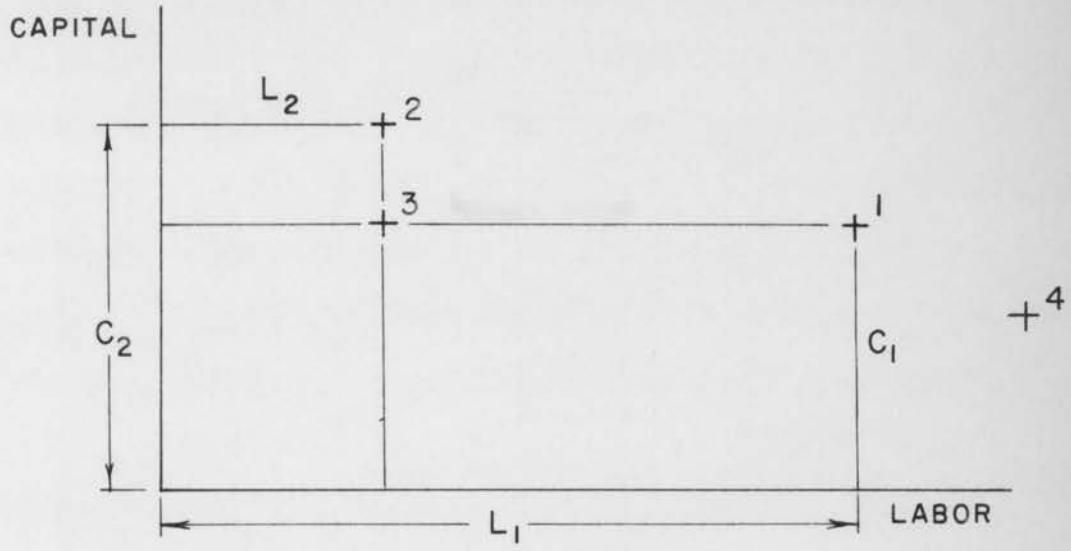

Figure 2. Technological possibilities

Assuming continuity, such points may give rise to a "curve of technological possibilities" which is a measure of factor intensity at any given time. Thus, it is possible to use a process which requires more labor rather than capital; and to economize capital relatively to labor. This argument will not apply to the whole economy because there are some regions where labor is scarce too and because some capital has to be used even in areas where labor is in surplus. For instance, in the mechanized crop production schemes, shortage of hand labor ranks first and most important. Nothing is done mechanically except discing and sowing. The rest of the agricultural operations - weeding, cutting and threshing are done solely by hand labor. But the hand labor is depressingly scarce. The laborers are more attracted by the cotton-picking in Gezira and Gash. This chronic problem, besides raising the cost of production, gave, and is still giving rise to subsequent difficulties. Some of the crops grown like sesame are of the shattering varieties and it has to be harvested at the right precise time; otherwise it will shatter and be lost. This is also an inevitable outcome because labor is scarce.

A potential success element is that labor could be saved if non-shattering varieties of sesame become available. Likewise, if popular and good yielding combinable varieties of sorghum are produced. Thus at least a minimum amount of capital expenditure is required for research and the development of new processes and materials appropriate to the circumstances.

Several types of technological change exist. Swanson has suggested

three types of technological improvements (Swanson 53, pp. 113-115).

1. Technological change involving an increase in yield per acre accompanied by a decrease in cost per unit of product. Examples of this are new crop varieties and fertilizer.

2. Technological change consisting of a reduction in nonland cost per unit of product but without an increase in yield per acre. Swanson has described these changes as occurring by the substitution (along a given isoquant) of one nonland input for another nonland input. Mechanization is a case in point. In many instances, it had little or no direct effect on yield. Here the availability of capital will act as a restriction limiting the adoption of such a technological change. In some regions of Sudan, it will be desirable if possible, whereas in other regions, it is not a necessity. So the objective will be to provide many alternatives that will suit every region in the sense that the same output can be produced with the least-cost combination of inputs or otherwise the provision of a maximum output that can be produced with the given set of resources.

3. Technological change which have the effect of improving transportation. Such a change will generally be more favorable for the removal of a serious obstacle that lie in the way of furthering agricultural development in Sudan. The need for capital in this area is urgent. And the possibility of building roads is in direct conflict with other changes that require capital.

Now we should consider each of these types of technological changes in turn.

Yield-increasing technology

An increase in the aggregate output can be attained by a labor-intensive technology as well as by a capital-intensive technology. In the former case, the production of food commodities can only be boosted to a higher level if the unused labor is drawn out of agriculture because of the very high labor-capital ratio in this sector. Thus, in this sense, a labor-intensive technique will be defined as one that involves the transferrence of labor from the agricultural areas where it is in excess

to the non-agricultural areas where it could be employed more intensively into productive uses. Even in this case, capital expenditure is necessary if only the laborers are to be paid wages, let alone the provision of materials which are vital for the establishment of a particular scheme.

In the case of using a capital-intensive technology, more capital is required in the form of improved insecticides, fertilizers, strains and varieties of crops, new breeds of cattle, new feeds or even new machines that are to be used in manufacturing activities, and in building and construction. For those categories of inputs that involve biological improvements in agriculture, the capital-labor ratio would be lower than for those categories of inputs that involve heavy expenditures of capital (for example, the construction of a textile plant).

Progress in agriculture in a country like Sudan seems to depend greatly upon the development of new techniques. This does not call for large sums of capital and it could be achieved with the minimum of capital intensity. In fact, Japanese agriculture is one of the most productive in the world and it has maintained its efficiency overtime through labor intensification. Of course, management might not be as efficient as it is in a more advanced country like the United States, but the cheap cost of labor might compensate for this. An argument which is recognized by the advocates of the labor-intensive techniques is that the prevalence of these techniques in the agricultural sectors of less developed countries "are so inefficient that output per unit of capital, as well as output per unit of labor, is lower than with more advanced methods" (Higgins 44, p. 668).

Higgins has shown that yields per hectare are lower, even with the labor-intensive methods of Asia and Africa, than they are with more mechanized techniques in advanced countries (Higgins 44, Tables 1-4 and 1-5, p. 16). But this evidence is not by itself an adequate argument that calls for the adoption of capital-intensive techniques. Figures about some crop yields say nothing about the relative factor prices. In terms of prices for labor, we will hypothesize that cost per unit of product in a less developed economy might in all likelihood be less than the cost per unit of the same product in a more advanced economy. Furthermore, the provision of new techniques that will cause insignificant changes in the capital-labor ratio might raise the output per man-year, assuming that such techniques are selected in a way so as to increase productivity per man-hour by the acquisition of better skills and knowledge, better tools, and the advocation of measures that will bring about a decline in natural population growth.

The limitations of this approach revolve around the question of choosing the appropriate technique and the reluctance of the rural people to adopt a new practice due to ignorance and lack of technical skill. With regard to the first limitation, economic criteria ought to be followed in the search for the most efficient technique. As stated by Higgins, "the country should use the technique that will contribute most, for a given cost as measured with appropriate accounting prices" (Higgins 44, p. 675) to the aggregate output. In most cases, it is difficult to decide what this technique is because of the lack of data which will give adequate information about the cost and the marginal value productivity

of a particular input. However, some slight indication will be given by the urgency of needs, the availability of natural resources, and the contribution to a particular end-in-view during a "crucial period". The crucial period in this sense is defined as the time horizon of the planner and it will be a determinant of the labor and capital available. A technique can always be measured by an isoquant.

Given the production function, Figure 3 shows how the level of output represented by the isoquant $I_1 S_1$ can be attained with different combinations of labor and capital. To increase the product to higher and higher levels ($I_2 S_2$, $I_3 S_3$, etc.), we can draw heavily on labor and use smaller and smaller increments of capital. Capital representing old forms (primitive tools) is to be replaced by capital representing new forms (improved tools). In this case, it will be expected that the entire production function will shift because a better technique is adopted and a new set of isoquants of a higher order than those in Figure 3 will emerge.

Also, if there are different processes as process 1 and process 2 defined in Figure 4, we can always choose inbetween techniques provided that our choice is limited to a finite number of combinations of labor and capital.

Process 2, for example, may be the supply of fertilizer by a government agency and slight improvements that are to be made in the oxen-driven plow. Process 1 is the building of an irrigation dam. Process 3 is unfeasible because it requires a larger amount of capital relative to labor, and therefore, it does not lie inbetween the techniques available.

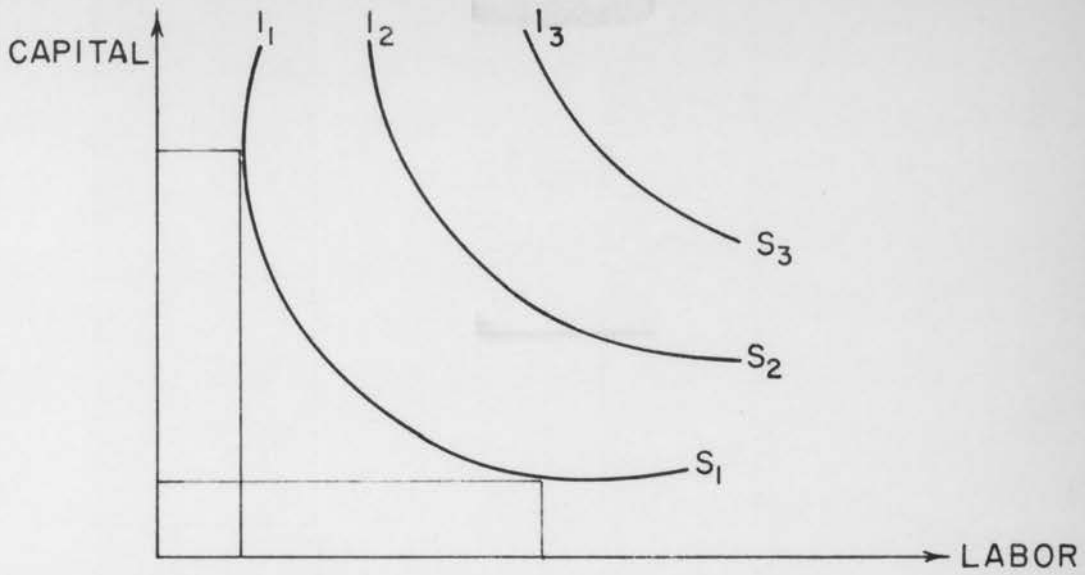

Figure 3. Capital and labor intensive techniques

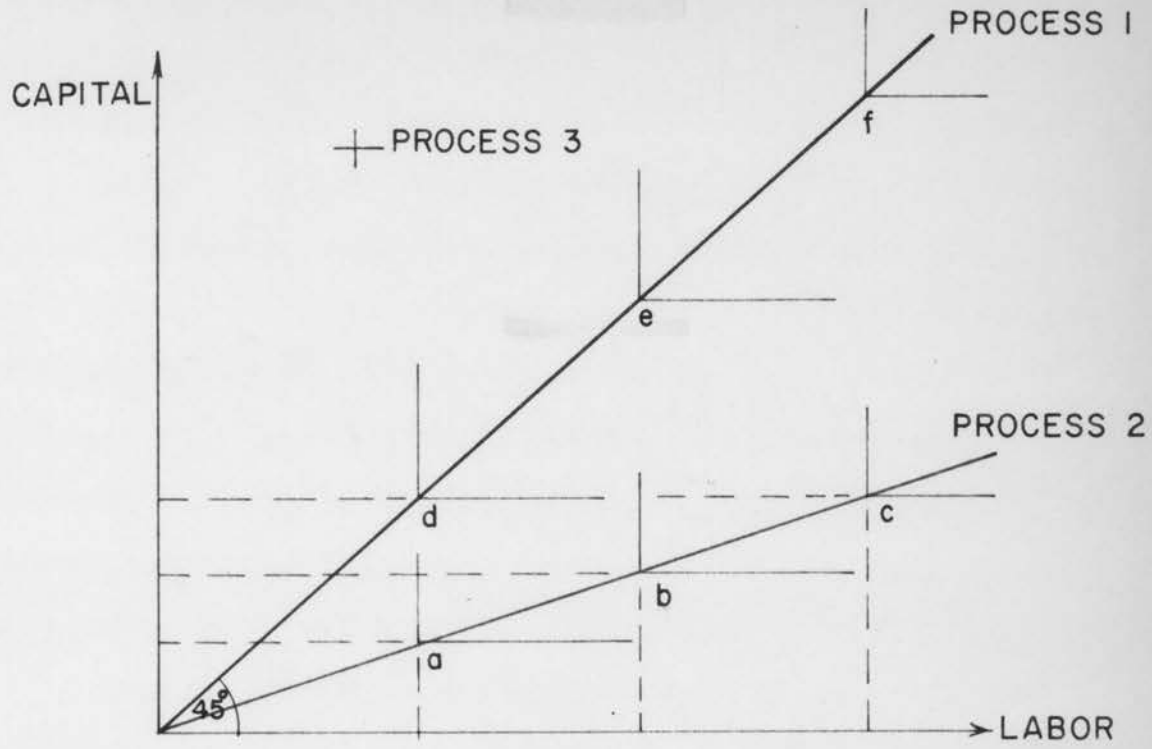

Figure 4. Choice of inbetween techniques

The different points a, b, c, d, e, and f show how increasing amounts of labor and smaller increments of capital can be utilized to produce a higher level of output. Any combination inbetween P_1 and P_2 represents a process that renders itself available for choice in agriculture.

Technical programs concerned with increased productivity must take account of the way people think and behave and of their relations with each other. Attention to spiritual, social and cultural elements is as important as technical assistance to productivity or to improvements in housing and health. Frequently, relatively simple measures which seem obviously desirable to the outsider are not accepted by the rural people because they conflict with other elements valued more highly. It is relatively easy to build schools, construct dams and introduce chemical fertilizers but it is not that easy to change the volition of Azande tribesman and his attitude towards work if he is not willing to do so. What is feasible under economic conditions, may not always be adequate, automatically, in the rural sphere, where the human factor plays a much more important part in the economy. Those concerned should not forget that the richest resources of a country lie in the untapped powers of its people, so that it is, in the first instance, these powers that have to be activated. As an illustration of a one-sided approach, we might consider the tillage of the land by means of ploughing, which can have, other things being equal, many advantages over the hoe or digging stick. And let us assume that a campaign for the use of ploughs is started in Southern Sudan where the people in question are the holders of many herds of cattle. This means we have to abandon hand-hoe agriculture and

restrict the area for cattle grazing. And even if the people are willing to use their animals for draft, which is not quite foreseeable, in doing so, we are actually violating a deep-rooted way of life where the "Nilotics" consider cattle as a beloved sacred wealth; and hoe culture as the most efficient means for the cultivation of staple food crops. Ownership of cattle in this area play an anti-economic part since it is only the number of animals that counts, and not the quality per head. Also much land is occupied that could have a more remunerative use; every year vast areas are exhausted by over-grazing.

Another example is that many southerners believe that an egg if eaten by a wife will cause sterility. Eggs are known to have the highest biological value and they constitute a nutritious item of diet which can be introduced for improvement of malnutrition and disease resistance. Still, the introduction of poultry farming in such a case might not be a success in the short-run.

Hence, the introduction of new techniques may be hampered from resulting in a social change by socio-cultural attitudes. However, possibilities for improvement exist. Education or persuasion can create new wants. Dissatisfaction may arise, and this may consequently provide the drive towards betterment. Knowledge is a necessary basis for improving a situation. Pilot or demonstration projects are a potential success element. For example, if we want to settle the people around the proposed "Roseires dam area", we need to get rid of the cattle they own. This can be made use of in a system of mixed farming. The nomadic tribes will not be convinced by such a system of farming until they see

its success. Thus, farm centers and demonstration farms could be established. Good farmers and competent field men should be given a chance to show their skill. Cash crops could be grown and cattle could be integrated in the scheme. Such a system could only be justified and desirable if the people themselves are made to feel its success through their own practical experience and adequate observation.

Again, if we are to expect successful coffee farms in the South, we have to settle people in villages in low-lying areas. Farms ought to be distributed to individuals who have shown interest and have proven to be outstanding cultivators. It is no use to allocate demonstration farms for chieftains because the people have the feeling that these are given authority by the government to do them evil. And so, they will not accept their advice. Coffee will be regarded as a "Hakuma" (belonging to the government) crop - the same as cotton is now in the Zande scheme and consequently, coffee cultivation is bound to fail.

Studies of significant experiments may provide guidance. In this connection, it is worthwhile to think also of another way of stimulating the pattern of wants. This is based upon the speculation that the villagers' wants will be aroused by the sight and the supply of newly available consumption goods. These goods are usually referred to as inducement goods and they have a special attraction to the people concerned. So they serve the function of arousing more inclination to produce more via the desire of income increase.

Cost-reducing technology

In the previous section we have stressed "scientific technology" as opposed to "machine technology". Mechanization of agriculture is cost-reducing if labor is scarce. It is also yield-increasing because it allows timely operation. This is usually the case with crops that are to be sown in a very short period of time and for such an operation, a native plow with labor cannot possibly be as efficient as a seed drill. Furthermore, increase in productivity can be forthcoming with shift from animal power to tractor power due to the diversion of land from feed for former to the production of cash crops that will be sold in the market. This has its disadvantages, too. Animals are an inseparable part of agriculture and their presence in farming is complementary in the sense that they can provide manure for improving the fertility of the soil. Also a man with his own cattle can supply all the requirements of himself and his family, and obtain a surplus balance as a return for his labor and extra capital expenditure.

It is conceivable that the prospects of mechanization are only promising in little spots compared with the vast area of the country, that is, in areas where labor is scarce. Only in this sense mechanization will be regarded as a reflection of a state of technology that might be of a cost reducing nature. Advanced countries like the United States have every justification for the use of machine technology. Labor is scarce and capital is cheap. In a less developed economy like Sudan where labor is cheap in most regions, it is not necessary at all to achieve economic growth through capital-intensive techniques. This

follows directly from the fact that the per-unit cost of producing a product by a machine is relatively higher than the per-unit cost of producing the same product by manual labor.

The mechanization approach has only a limited capacity to explain or to solve agricultural maladjustments. Walter has given one of the arguments against mechanization in the following words:

> "... where men without modern machinery, but by raising commercial crops, depleted the soil in a generation or two, men with machinery can deplete it in the short span of five years. As in other fields, the machine has led to a tremendous acceleration, sometimes in the alleviation of drudgery, at other times towards the destruction of society. The irrational machine can build or it can ruin. The crucial factor is the human direction which determines the purpose of its use" (Walter 54, p. 55).

Not only is it necessary to direct the purpose of machinery use but the know how of its use is equally important. One of the important problems that usually accompany the introduction of machinery is the provision of skilled operators for the machines, and skilled mechanics who can look after them. The shortage of spare parts is also a source of complaint. The lack of an adequate transportation system aggravates the problem of fuel shortage during the rainy season. On the whole, it seems that the disadvantages of mechanization outweigh its advantages. But still we cannot condemn mechanization. Sudan is made of heterogenous regions. Different alternatives exist for every region. Our concern is to analyze and appraise the different alternatives associated with the physical considerations of every one particular region, and then we have to pick what is economically possible, socially desirable, and technically adequate for the area. For example, it will be unnecessarily expensive

to introduce mechanization in the sands of Kordofan because (1) the cost of introducing the machinery will be too high to justify the investment, (2) the people inhabiting the area do not know how to use a tractor for instance, and (3) because of the arid nature of the area, machines will aid in the deterioration and depletion of soil fertility. On the other hand, it would be wise to expand the use of machinery in the mechanized crop production schemes where labor is scarce granted that the other deficiencies enumerated above could be remedied.

From a social point of view, the introduction of machinery in some areas might not be desirable and an innovator who uses machines on his farm might be regarded as an outcast. Moreover, in areas where labor is in surplus, the introduction of mechanization will displace human labor. There is no great likelihood that the displaced farmers will be absorbed by industry. Hence it seems that mechanization is a source of trouble rather than betterment.

However, it is doubtful that the mechanization of Sudanese agriculture will follow an evolution from the primitive digging stick to the most complicated motorized cultivator. Generally, areas where labor is scarce ought to be mechanized despite the difficulties encountered. Meanwhile, increases in productivity in areas where labor is cheap could be achieved through the adoption of the "scientific method."

Transportation improvement and technological change

Present deficiencies of the national road network represent a serious obstacle to furthering agricultural development in Sudan. Lack of roads and inaccessibility to the markets is a most serious impediment to

agricultural progress. Vast areas of productive land are lying idle because of the lack of an adequate transportation system. It has always been mentioned with truism that the location and accessibility often play an important part in determining the uses for which various tracts of land are suited. Barlowe attributes this to three factors (Barlowe 55, p. 31):

1. Man finds it more profitable to concentrate his efforts on most rewarding portions of his land. This is evident in Sudan where most of the agricultural production is concentrated in those areas which are heavily populated and which enjoy locational advantages over others. On the other hand, there are agricultural regions like the H.C.P.S. where production of grain is enormous but transport is inadequate.

2. The need for bridging the spatial gap separating various areas by the provision of adequate transportation facilities.

3. The effect the principle of diminishing returns has in forcing man to spread his productive activities over extensive areas of land. This is exemplified clearly by the nomadic way of life in Sudan. The nomadic tribes shift from one area to the other in search of water and grass for their animals. They only do that just at the time when the area on which they practice their grazing starts to yield diminishing returns to them and their animals. We might even hypothesize that had there been an adequate transportation system, the tribes would have been settled easily because by improved means of transportation the supply of water may not be a problem.

The size and the geographical extent of the market are limited

because of the lack of proper roads in Sudan. To realize any appreciable increase in the output of agricultural products further expenditures on the transportation item are needed. Improvements in transportation and communication are a type of technological change that has an expansion effect. This is conceivable because such an improvement will result in a cheaper transportation cost and some farmers might find it more profitable to produce their crops away from the market (assuming that the value of land lying at a greater distance from the market is less than the value of land lying nearer the market). Moreover such a change will result indirectly in locational changes in population (Baker 56, p. 106). Due to the opening up of new railways, more opportunities are made available and the outcome will be a change in land use patterns. An enlarged market will in this way result in higher mobility of factors of production and greater efficiency in the sense that it will encourage investment into productive use.

Improvement in transportation over time may cause significant aspects of transformation in the country. Above all it will definitely aid in the transition of production from a local level to the national level. The Von Thunen's concept might as well serve the purpose of illustrating the impact of transportation facilities and location upon land utilization practices with respect to the principal marketing areas of the country (Renne 57, p. 370). Holding constant all of the natural factors affecting land use, a pattern of farming can be laid out whereby areas near the cities would be used in an intensive manner to produce perishable products such as vegetables, which means a comparatively lower cost of

transportation is enjoyed. As we move away from cities and town perimeters extensive use of land would be advocated for purposes such as grazing, whereby animals produced could be driven to market. Such an arrangement will offer increased production for sale and will give rise to an increase in the importance of marketing.

For the last few years expenditures for road building and maintenance have been taking up a substantial part of the government's development outlays. However, still there is much to be desired. Sound economic and technical research instead of local considerations represent success elements in this area. Costs ought to be carefully estimated since the need for transportation competes with other projects for the scarce factor, capital. Studies should pay proper attention to the economic potentials of any one particular area before priorities are established or funds are committed.

CHAPTER FOUR: CONDITIONS FOR MAXIMUM PRODUCTIVE CAPACITY

An Application of Hirschman's Concept: DPA vs. SOC

Hirschman, in his book, The Strategy of Economic Development, visualizes economic expansion as a mixed "stair-case" sequence between SOC and DPA that continually overshoots balance, and thereby sets up alternate investment pressures. At the outset, the author emphasizes the scarcity of the "ability to invest" and make decisions in the less developed countries. Then he proceeds to point out the problem of the allocation of resources between social overhead capital (SOC) and direct productive activities (DPA). The definition of these concepts has been given in a previous section. The interrelationship of SOC and DPA may be further explored by means of a simple diagram used by Hirschman: The curves a, b and c portrayed in Figure 5 may be considered as cost curves for three different levels of output. Each curve is of a higher different order as we move away from the origin. Units of investment in SOC are measured on the horizontal axis, and units of investment in DPA on the vertical axis. The Curves merely reflect the variations in the cost of a given output as only one element (SOC) is being altered. The reason for the slope of the cost curves is as follows: At the far right of the diagram, SOC is plentiful and the costs of DPA are low. As we move left, costs for a given amount of DPA output rise slowly at first and then rise rapidly. The curve may eventually become vertical which would imply that there is a minimum SOC necessary before any output of DPA will be forthcoming.

The objective for the economy would seem to be able to obtain

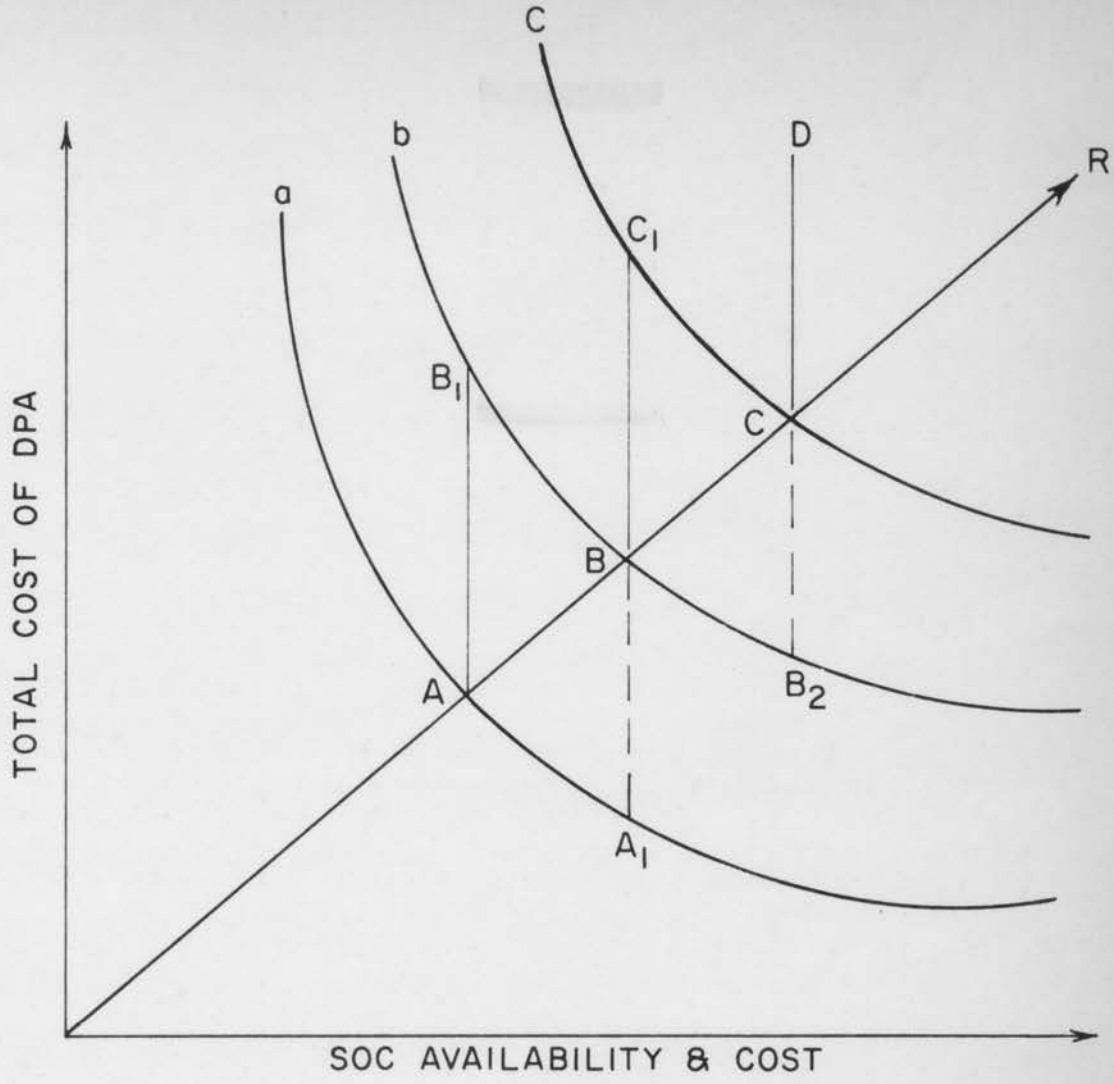

Figure 5. Investment in SOC vs. DPA

increased outputs of DPA at minimum costs in terms of both DPA and SOC costs. For each level of output, the sum of the two costs would be a minimum at the point where the line OR cuts the cost curve. The ideal expansion of the output thus will be a movement upward along the line OR. In this manner the balanced growth between DPA and SOC would make most efficient use of the country's resources. However, Hirschman believes that balanced growth is not feasible for less developed countries, and therefore, SOC and DPA cannot be expanded at one and the same time. Preference must go to the sequence which will lead to the optimum inducement to invest. It is apparent that this sequence may be one of two forms: (1) The expansion may begin through an increase in SOC in which case the expansion path will follow the dotted line AA_1,BB_2C as shown on the diagram, or (2) the initial expansion may begin by an increase in the output of DPA in which case output will increase along the line AB_1,BC_1,CD. The decision as to which path is the most desirable is not an obvious one. With an initial increase in SOC, the cost of DPA would be lowered and would perhaps lead to an increase in the output of DPA because of the expectation of higher profits. On the other hand, if DPA is expanded first, production costs will rise and the producers of DPA will exert pressure upon the government to increase the availability of SOC. However, it may not seem plausible that expansion of the output would begin by an increase in DPA in view of the rising costs. Given the stage of economic development, it seems that the only possible way for the Sudanese economy to raise its output per head, is to expand development via SOC provided that capital and technicians are made

available to the country through other means. Even after the provision of these resources, economic growth would be unbalanced because technicians require a certain time to get adjusted to the new environmental conditions which means that a "waiting cost" would be incurred. Of course, such a situation is not going to last forever because as soon as capital is realized through increased production, and when skilled people indigenous to the country are made available, the strength of "entrepreneurial motivation" will be stimulated. And as the economy is viewed as a unit made up of interdependent parts, then it would become apparent that investment could be made on a broad front in order that the various parts of the economy can move forward in balance.

The "Balanced growth thesis" emphasizes the point that there must be some internal consistency in the pattern of production. Meier and Baldwin in their exposition of this thesis suggest that if investment occurs over a wide range of industries, there is an overall enlargement of the market as one industry provides a market for another industry's output - a complementary system of different industries reduces each industry's risk that it will not be able to sell its product. To insure that increased production in one sector is met by increased demand from another sector, a wide range of investments in a number of different industries is needed. A balance is also necessary between domestic trade and foreign trade (Meier and Baldwin 58, p. 347).

It might then be possible for the planning agents to allocate DPA and SOC in such a way as to bring about the greatest economy. That is

why Hirschman's first condition[33] fails to hold over time granted that the government of the country is stable, and consumption is not increased beyond the necessities of life.

This sequence of development assumes a mixed public-private enterprise system in which the policymaker has a definite role to play by initiating certain kinds of investments which will help in inducing the desired private investment. Thought must also be given to the use of various instruments such as credit and taxation as a means of stimulating investments in DPA. However, the evaluation of the "efficiency" of investment pressures and incentives referring to DPA and SOC, respectively, depends on the strength of entrepreneurial motivations on the one hand, and on the response to public pressure of the authorities responsible for SOC on the other (Hirschman 5, p. 88).

Also, in his approach, Hirschman deals with one concept of extreme importance which is the concept of linkage. Here the concern is with two inducement mechanisms: backward linkage effects (input - provision), and forward linkage effects (output - utilization). Hirschman has made the effort to explain how the development path ought to be modified so as to maximize the advantages of external economies and complementarities that come under linkage effects even though the existence of input - output statistics supplies the economy with a few tools for an analysis of this kind.

The input-output analysis is concerned with the interdependence of

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[33]The condition that SOC and DPA cannot be expanded at one and the same time.

sectors of the economy. The sectors may depend on each other as consumers of products, suppliers of inputs or both. In the first case, there is a backward linkage. Examples of backward linkage are consumer durables, automobiles and finished consumer goods. Examples of forward linkage are the steel industry, coal mining and electric power. Again backward linkage can be defined as the ratio of inter-industry purchases to total production, and forward linkage as the ratio of inter-industry sales to total demand.

Hirschman has argued that total linkage effect of the establishment, in a given country, of the industry W is given by the formula

$$\sum_{i=1}^{n} Xipi,$$

where XI (potential importance of the linkage) is the net output of the industry i which would be called forth by the establishment of the industry W; pi (the strength of the linkage effect) represents the probability of industry i coming into being; and n is the number of industries to be linked to the industry W. pi would be given by the formula $\frac{Yi}{Ai}$, where Yi and Ai would have different meaning according to the type of linkage (Hirschman 5, p. 101). For backward linkage Yi is the output required by W from industry i, and Ai is the minimum economic size for industry i, i.e., the "size at which the domestic firm will be able both to secure normal profits and compete with existing foreign suppliers, taking into account locational advantages and disadvantages as well as, perhaps some infant industry protection" (Hirschman 5, p. 101). For the case of forward linkage, since the market for industry i would not depend on the

industry W, one possible measure could be using Yi as the inputs that industry i would use from industry W, and Ai as the eventual output of industry i.

Hirschman's concept is to look at development from a mutual interdependent framework where all sectors are related to an input-output coefficient. It is not necessary to start in agriculture or industries that use very low levels of capital. It might as well be possible to start with DPA. We have seen that this might not be the case with Sudan but this does not mean a rejection of the concept because a stage of development will be reached whereby the structure of the economy might allow the application of such a model.

Furthermore Hirschman classified the industries to be linked into "satellites" and "non-satellites", with opposite characteristics. The characteristics of the former are:

(1) strong advantage from its proximity of industry W;

(2) either the main input comes from W and is not subject to elaborate transformations or the main buyer of its product is W, to which industry i is usually a minor supplier; and

(3) its minimum economic size is smaller than that of industry W.

Given the large "importance" of the non-satellite industries (Hirschman 5, p. 103) - by definition they have large Xi and small pi - efforts should be made to increase their strength. Moreover, Hirschman argued that the "linkage effects of two industries (non-satellite) viewed in combination are larger than the sum of the linkage effects viewed in isolation" (Hirschman 5, p. 104). And this is one of the elements

responsible for the cumulative character of development. The establishment of some industries one after the other cause acceleration in the growth process.

He also refers to the usefulness of input-output analysis for the appraisal of the comparative "importance" of the linkage effects. For this, the data to be used should come not from the specific less-developed country, but from developed countries it will eventually resemble. In this connection, the application of such a model faces an insuperable difficulty. May be a country can borrow experiences, but to borrow figures for planning is not to be recommended at all. An alternative to go around this problem is to expand development via SOC with the means available till a stage is reached where the country can secure its own data. Such a waiting process is definitely time-consuming but at least it is a way of avoiding the errors that might be committed by super-imposing an economic structure which will be of a completely different nature. This is to be felt more even when the industries are to be ranked according to their linkage characteristics.

Hirschman also believes that backward linkage is more effective than forward, although the latter "acts as an important and powerful reinforcement" of the former. Industries have more relevance than agriculture in the development process, because their linkage effects are more significant. No one can contradict this empirical statement. But in the early stages of development an agricultural country cannot do without its agriculture. And even though its linkage effects are relatively low agriculture is the only resort for development granted that no

other source is willing to finance development. Abstracting from this limitation, Hirschman's theory suggests that for less developed countries industrialisation should start not with the basic industries, but with those performing the "final touches." This will result in an "import enclave industry," which will be similar to the "export enclave activities," differing from them, however, by the easier breaking out of the enclave situation, since the backward linkage effects are "of practically infinite range and depth." One of the merits of this type of industrialization is that it makes possible the industrialization process even in case of small markets and scarcity of technical knowledge and organizational ability. But the cost of such advantages is the resistance of the importing sector to the establishment of intermediate and basic industries. This resistance has some foundation as Hirschman points out. To overcome such a resistance "it takes a fairly violent shock - usually resulting from balance of payments or inflationary disturbances."

Hirschman points out that investment decisions taken as a result of forward and backward linkage are both valuable for being of the type "easy to take." In this case he suggests that intermediate industries should have preference over the "last industries" depending on the economic feasibility of the former. Hirschman suggests the construction of a growth model based on backward linkage as "a prime mover." The assumptions of this model are:

(1) there exists a very slow autonomous growth as a consequence of some net capital formation, improvement in efficiency and rise in exports,

(2) net capital formation comes about whenever imports of some commodity pass the "threshold of minimum economic size", i.e., whenever the p_i for the corresponding industry attains unity, such an industry is established in the country,

(3) there are imports only of commodities not produced domestically, and

(4) there are n commodities of which k are imported for intermediate demand and/or final demand (Hirschman 5, p. 113).

With such assumptions an input-output table with disaggregation of imports can be prepared. Granted that a knowledge of the growth of various import categories through time, the minimum economic size of the industries to be established and the corresponding capital requirements is furnished; it could be possible to see how, at different periods of time, industries could start being established. At first imports would flow inside the country to satisfy a fairly constant and specified increase in final demand. At this stage of the growth process the imports would be less than the corresponding domestic production threshold defined by Hirschman as "the minimum economic size at which domestic production is undertaken" (Hirschman 5, p. 114) with the growth in demand there will come a point at which imports will be equal or larger than "minimum economic size" because the "prime mover" would now be strong enough to cause an additional net capital formation; consequently this would result in the establishment of the corresponding industry. The derivation of the induced investment pattern for such an industry is likely to display "strong ups and downs even on the assumption of a perfectly smooth pattern for the growth of demand" (Hirschman 5, p. 114). The pursuit of such a kind of a

notion could help in explaining the "sudden spurt of investment relative to income" at the Rostowian "take-off" point (Hirschman 5, p. 115).

Rostow defines this stage as one that requires a very substantial increase in the investment rate and will result in actual resource endowment of the country; hence the capital-labor ratio and the capital-land ratio would increase substantially. Also two forces will work on the capital-output ratio: 1) a very vast requirement of SOC which usually has an extremely high capital-output ratio, and 2) during this period there are large potentialities for the exploration of new techniques, (also disquised unemployment) which call for a high productivity of capital. In summary form, three conditions are explicit in this stage:

(1) The rate of productive investment rises considerably,

(2) beginning of an industrial sector which will siphon off the labor force from agriculture, and

(3) there is a need for the quick emergence of a political, social and institutional framework which will make possible the absorption of the impluses in the expanding sector (Rostow 59, p. 39).

Maximization of Per-Capita Productivity

Our previous study has provided us with the following indications:

1. Even though agriculture is the largest sector in the economy yet its contribution to the national income is less relative to the recently flourishing industrial sector; the reasons being:

(1) Labor and land are unused and underused.

(2) Technology that could be expanded is held at a constant

level within the agricultural sector.

(3) Existing institutions act as impediments to the growth of per capita productivity in agriculture.

2. The industrial sector has maladjustments of its own which resemble those of agriculture but its per capita productivity resembles a norm for that of the agricultural sector.

3. There is a new source of resources that can enhance productivity in both sectors. This new source can come from:

(1) The unused productive factors.

(2) The inefficiently used productive factors.

(3) The scientific knowledge that can be borrowed from abroad.

The end-in-view pursued throughout the study is the achievement of a per capita productivity in the agricultural sector that compares favorably with a growing industrial sector. Many defects that lessen the achievement of this end-in-view are enumerated. But tremendous potentialities for its attainment exist. As Heady has mentioned a country needs to build up its SOC investments which will provide "quick turnover" (Heady 50, p. 87). Public investments or aid in railroads, schools, and general utilities require a long period for pay-off. The agricultural sector represents a good means of achieving this. Because land and labor are abundant relative to capital, small investments in improved seed varieties, improved husbandry, fertilization and better rotations could give a large and relatively quick increase in per capita productivity. Accompanying this, is the use of this sector as a labor flow regulator for the provision of labor to the industrial sector where it could be

utilized for the advancement of capital formation and consequently more capital to be fed back into productive uses.

Changes in institutions that are conducive to economic growth are a necessary means for developing agriculture. The supply of knowledge should be increased to a level where the desirable changes in the institutions could be effected. Thus it seems that the public sector has to play a major role in the economic development of agriculture. An increase in agricultural production could be achieved through increased input of resources. And this would only be possible by making better seeds and more advice available to the Sudanese farmer as well as educating him and his children.

The private sector should not be ignored. Farms could be developed commercially by private enterprise. This in itself could be an attempt at encouraging local innovations and improvements since individuals with large sums of capital might add more to the knowledge needed in research and development if they see the opportunity.

Rich and developed countries of the world provide a tremendous opportunity for increases in per capita productivity of a country like Sudan. Help and assistance are expected and they could be obtained with generosity provided that the help is not malused.

Finally, "using Rostow's take-off point, in rapid economic development with emphasis on industrialization, agriculture is important in providing conditions for "take-off" (Heady 50, p. 89).

CHAPTER FIVE: SUMMARY AND CONCLUSIONS

A broad outline has been provided in an effort to apply some of the economic concepts associated with the problem of economic development to the Sudanese economy. The very fact that Sudan has rich natural resources in relation to population should tend to provide more scope for increased productivity in agriculture. The bounties of science should help enormously in speeding up the many steps which have been taken hither to improve the lot of the people. The planning programs that have been set up are hampered by lack of funds and foresight. For years to come, serious efforts should be made to step up planning for meeting the requirements of the nation.

The study was carried out on the basis of the realization that the Sudanese society is interested in achieving an increase in per capita productivity of its primary occupation - agriculture. The extent of this increase is assured at a level which is at least equivalent to that of the recently developing non-agricultural sector. It is also expected that the development of agriculture will enhance the per capita productivity of the non-agricultural sector through the provision of capital, laborers and raw materials.

Many obstacles facing the achievement of such an end-in-view have been examined. The model elaborated is not subjected to empirical investigation because of the lack of data. This in itself is an impediment that needs further treatment and it is a basic element for practical economic research from which future courses of action could be fashioned.

Structural defects in the economic organization of the country make

it dangerous and difficult to apply a theory worked out within the historical framework of the industrially advanced countries for the solutions of the local problems. The reference being made here is to the declining contribution of the agricultural sector. Heterogeneity among various countries of the world and the fact that each agriculture has its own outstanding characteristics restricts the validity of such a concept. This, however, does not negate the possibility of expanding the industrial sector because a transfer of the agricultural population from certain regions to industrial occupations is one of the necessary conditions for optimizing the per capita productivity within the agricultural sector. It seems desirable that the economy should follow a series of short-run zigzag (as that shown in Figure 5) developing first agriculture then industry and coordinating each stage so as to provide a momentum as well as a source of economic power via which industrial development could be enhanced. Of course, it is also conceivable that industries other than agriculture could be developed from foreign sources through aid, loans, or grants provided that adequate knowledge is associated with such a development. This is so because the supply of capital cannot substitute for knowledge.

Land and its structures in our study is considered as an agglomeration of institutional factors (like the tenure system and the credit system), and as a source of wealth for supplying the raw materials that could develop other industries. In the former sense the creation of new institutions such as supervised agricultural credit, marketing boards, the consolidation of small fragmented pieces of land and efficiency in

farming methods or conservation measures should lead to a general rise in the productivity of land. And if we define this as agrarian reform then the economic development of agriculture is an inseparable part of this concept. In the latter case, there are still, in Sudan, large areas of productive (actually and potentially) land that can be developed for cultivation and grazing. If land and labor resources are favorably arranged and given that labor is scarce, then mechanization can raise per capita productivity and this can create the necessary surplus adequate not only for a higher standard of living within agriculture but also for industrialization.

Our analysis has also given us a clue that labor is underemployed in agriculture. Not only that but ignorance and lack of education are very serious impediments to economic growth. The problem of underemployment could be handled by taking off a certain surplus number of chronically underemployed laborers. But it is likely that those individuals will be the least capable persons from the point of view of physical fitness and the most unsuccessful farmers. This is aggravated more by the possibility that the people who are desirous of moving are the more able farmers because of their relative flexibility and mobility. Thus, besides the establishment of a new industry, serious attention should be given to the impact of such consequences on agriculture. However, there is a wide gap to be closed before labor in agriculture can raise its productivity through education and also before it achieves that necessary degree of mobility and flexibility that will allow it to take full advantage of the development of other industries.

In dealing with capital some important aspects are raised too. Capital could be initially secured for the development of industries from foreign sources, or otherwise through increases in the productivity of agriculture. But even in the latter case borrowings and grants are necessary for carrying out improvements in the agricultural method. What is crucial, however, is the problem of allocating the resource capital among various projects. This deserves full knowledge of the practical situation under consideration. Furthhrmore, we have considered the differtential impacts of technology and their consequences.

Progress in Sudan seems to depend greatly upon the development, initially, of the new less costly techniques associated with the cheap resource labor in most instances.

Finally in considering the interrelationship between agriculture and other industries in the achievement of economic progress we should realize that:

(1) Agriculture is the primary occupation in Sudan and except for a few crafts industries and some of the recently developed light industries, an industrial sector as such is non-existent.

(2) Increases in per capita productivity within the agricultural sector can only be achieved through significant changes in the existing institutions.

(3) There are virtually unlimited possibilities for private enterprise to function if the desirable atmosphere is created via increased expenditures in SOC.

(4) The allocation of resources for development between agriculture

and non-agriculture must be determined by technical considerations, and by the determination of priorities according to requirements, needs and after a thorough examination of the alternative uses of the resources - land, labor and capital.

(5) There is considerable scope for Sudan to draw what it needs most from the large reservoir of knowledge made available by advanced countries. With technical assistance; limitations in data for planning development may no more be an unsurmountable difficulty.

Limitations of Study

The lack of specific empirical evidence relating to the quantitative impact of any structural reforms or changes on the economic system visualized is a serious limitation to the study. Scientific research in economic variables such as the per capita income, investment criteria, and input-output relationships, the changes of which are conducive to economic growth and planning, is very limited in Sudan, if not lacking altogether. Macro-economic behavior within the Sudanese economy could not, of course, be detected satisfactorily as long as empirical data for recent decades is scarce. Gains from projections could be achieved if knowledge as regards the economic situation and macro-economic behavior, could be improved. National-income statistics that can provide a good guide to investment if accompanied with the government's development budget have obvious shortcomings. Lack of figures for net - outputs, employment and the price level of important sectors of the economy is also a shortcoming. The non-existence of a suitable organization for

the collection of social accounts is a serious deficiency. The consideration given in our study to changes in per capita real income, population and production technology is hampered by the limitations enumerated above.

Suggestions for Further Study

Recommendations for research

Expansion of research facilities is of vital importance for the development of the country. It is not possible for instance to formulate recommendations for curing the relative internal inefficiencies within and between the various farming regions of the country if we do not have some sort of input-output figures that could be used for estimating marginal productivity. To propose rapid development without the provision of proper physical and economic data is extremely dangerous, and harmful. For example, there is no point in providing water supplies in pasture lands if we cannot analyse the situation as to how could we control grazing; reduce the animal population; and what will be the costs and benefits associated with such an achievement. In order that an optimum rate of benefits could be accomplished with a given number of projects, the available means (which are usually limited) should be used according to the needs. And this could not be carried out efficiently unless an adequate knowledge of the situation is furnished. All this indicates that extensive research work is a necessary guide for conducting any particular inquiry as delimited and directed by hypotheses. An attempt should be made to develop research projects for the collection of sufficiently comprehensive information. Complete coordination of all

projects is important in effecting a policy that will facilitate the undertaking of statistical inquiry. Interdepartmental liasion should be improved to promote greater efficiency and to eliminate the duplication of efforts. Any development program should be suitably balanced, keeping in mind its requirements and achievements. As a suggestion a statistical research center could be established whose main objective will be the collection of statistical information and its utilization for planning and development.

The importance of research and the promotion of knowledge for national planning and development has been recognized in principle by the Sudanese government. Progress has not been entirely satisfactory or adequate. There is still an urgent need for improvement at all levels. Any additional ameliorative programs concerned with different aspects of research have a great chance of success.

Refinements of data

Heady and Dillon emphasized that "the collection of data - whether it be by experiment or survey - is an integral part of research aimed at the empirical specification of production functions. The fitted function can only be correct to the extent that the data behind it reliably represent the production process. If the data are wrong, the estimated production parameters must also be wrong. Likewise, if the data are incomplete, only incomplete implications can be drawn from the fitted function. In short - shabby data can only lead to shabby results" (Heady and Dillon 60, p. 142).

Sudan is faced by lack of data; not only that, but the available data

are inefficient as well. Lack of data could be solved if research workers who are keen and eager can be employed. Furthermore funds have to be made available, and these are to be utilized where the productivity of research is greatest. A satisfactory knowledge of the production situation is of inestimable value in constructing a theoretical framework of the variables involved.

Efficiency of data may be judged by the achievements that can be obtained from the data collected. Heady and Dillon have enumerated alternative approaches to data collection. Two broad approaches were mentioned (Heady and Dillon 60, p. 143):

(1) the experimental approach, and

(2) the non-experimental approach.

For both, time series and cross-sectional observations can be obtained. In order to determine the efficiency of production of various farms in a farming region in Sudan for instance we can make the search for cross-sectional data from which we can fit some production functions that will give us some notion of the productivity of the resources employed. On the other hand, time-series data which consist of a whole series of observations made on a particular unit at different points in time could be made available for the estimation of agricultural production functions. And from this it might be possible to reflect some of the basic technological patterns.

However, the whole question rests on the procedures set out to gather the observations. The need to improve the estimation of the net-output of certain sectors has already been stressed. Also the variations in the

magnitude of the capital-output ratio offers an interesting suggestion for further study. Undoubtedly sampling methods offer the best hope of achieving this aim. A census, by sampling methods, of industry, of the animal population, more refined sampling surveys on consumer expenditure; employment, personal income, etc., will offer much needed knowledge. Even though the industrial sector is small, information about it would be valuable for planning expansion.

Surveys of natural resources of Sudan would be of great relevance for the preparation of a general long-term development plan and coordinated development of the resources available to the country.

However, surveys of this type will be time consuming and costly. It would, therefore, be desirable to spread them over a number of years. Also, there are numerous small establishments throughout the country whose number and location are unknown. Some form of an area sampling design would be needed. Equally, an estimation of the animal population is a tremendous task if we take into consideration the fact that many tribesmen wander in various parts of the country.

Sampling surveys by themselves will not furnish the necessary background for making future studies in the national income. It would not be desirable to make projections on which planning might be based on estimates that are made from data available for a short period of time. Consequently the government could establish industrial and agricultural year-books in which appropriate accounts of different items of the economy will be kept.

Finally it might be worth it to conclude our study by quoting the

following words of wisdom from Bernal's book - "World Without War."

> " ... with a rapidly growing civilization, the young will year by year have more to know and also, will be required, by the new demands made on them, to know more.... Something must be done to simplify and reduce the amount of learning at every stage.... In the past with some reason, teaching was considered to be the passing on of known and established truths from one generation to the next.... But clearly, in a civilization where the whole basis of knowledge is expected to change several times in a generation, the passing on of established knowledge becomes palpably inadequate and, also, from its overincreasing bulk, impossible. It is lucky if most of what is taught is true, or supposed to be true, at the time it is taught. It is certain that it will no longer be considered true by the time those who are taught are halfway through their lives. What is needed, therefore, is a different and lightened content of education. The emphasis will be on discovery rather than knowledge. It will be, not so much the passing on the established truths, as showing the way to criticise and discover new truths; in other words the active part of the scientific method" (Bernal 61, pp. 197-198).

It is with this attitude that the Sudanese people should be educated and it is with this same attitude that I have begun and pursued this study.

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